

REVISION OF THE OLIGOCENE FLORAS OF THE ISLE OF WIGHT

BY

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By M. E. J. CHANDLER

SYNOPSIS

The beds from which plant remains have been obtained are listed ranging from the base of the Upper Headon to the top of the Hamstead Series. Reasons for excluding the Lower Headon from the Oligocene are briefly summarized. The poor representation of the Oligocene land flora in the Isle of Wight is mentioned and the plant beds of the successive horizons, Upper Headon, Osborne, Bembridge and Hamstead are described. Plant lists from these beds are incorporated and are discussed in turn. In the systematic section almost all the records in the Upper Headon are new as are the few from the Osborne Beds. In the Bembridge Series there is a small collection of plants to add from the Bembridge Limestone and a few new plant localities in the Bembridge Marls. There are one or two corrections to the plant lists from the Insect Limestone published in 1926 but this flora is due shortly for reappraisal. The Hamstead Bed flora is still little known and is represented almost entirely by water or marsh plants which give the minimum of information about contemporary conditions.

INTRODUCTION

THE horizons from which plant remains have been collected in the Oligocene Beds of the Isle of Wight are, passing downwards,

The Hamstead Beds,

The Bembridge Beds, especially the Insect Limestone,

The Osborne Beds where only sparse dwarfed or battered specimens have been found,

The Upper Headon Beds.

The plants will be discussed chronologically starting at the Upper Headon and working up through successive horizons.

The Eocene plants, very few in number in the Island, have been described elsewhere except for the Alum Bay pipe-clay impressions which have not been revised in recent years so that a thorough study of the remains, mostly leaves, is needed but must await the attention of an expert in these organs. Unfortunately the macroscopic plant remains do not, at present at least, appear to help in the separation of Eocene and Oligocene.

Whereas some geologists include the Lower Headon Beds in the Oligocene (Reid & Strahan, 1889 : 127 ; Arkell, 1947 : 217) others have preferred to retain them in the Eocene (Wrigley & Davis, 1937 : 220, pl. 18). The latter position was adopted by Chandler (1961, table on p. 8). In the type localities of the Barton and Hordle cliffs there is a continuous section from the Barton Beds through passage beds into the Lower Headon while the succeeding Marine Beds (if indeed they represent the Middle

Headon Marine Series) are ill-developed. There are no Upper Headon strata. In the Isle of Wight the Upper Headon Beds are definitely and unmistakably separated from the Lower Headon by the well-developed marine Middle Headon with its "Venus" and *Neritina* Beds and Oyster banks, and the division between Eocene and Oligocene appears to be drawn more appropriately below these marine beds with Lattorfian mollusca than below the Lower Headon.

RESTRICTED RANGE OF PLANT REMAINS AVAILABLE UP TO THE PRESENT

The Oligocene plant remains of the Isle of Wight are disappointing after the relatively richer beds of the Eocene on the Mainland. Apart from the fine impressions of Bembridge age in the Insect Limestone at Thorness and Gurnard Bays (Reid & Chandler, 1926) very little evidence of the true land flora is preserved. The frequent mention of seed beds at a number of horizons in the Geological Survey Memoirs has in the past raised false hopes in the palaeobotanist for these invariably prove to be monotonous bands of gregarious water plants: *Stratiotes*, *Brasenia* and *Limnocarpus* with a limited representation of other genera like *Potamogeton*, *Aldrovanda* and *Typha*. There are in addition occasional finds in the Hamstead Beds of *Sequoia coulttsiae* represented either by carbonaceous twigs or by hollow impressions in cementstone or ironstone blocks. No one has yet discovered lenticles or pockets rich in the fruits and seeds shed by trees and shrubs clothing the banks of rivers or growing in woodlands adjoining them, although search has been made for such by numbers of workers including C. Reid, J. Groves, G. W. Colenutt, E. M. Reid and M. E. J. Chandler. No typical patches dark with the remains of twigs and woody fruits have been observed. The nearest approach to such is a sandy band below a sewer pipe at Linstone Chine, Colwell Bay, where scattered fruits are easily removed from soft sands by sifting. That it may be worthwhile to continue to search is suggested by the unique but important find in a thin seam composed of tiny shreds of vegetation in the Upper Headon of Colwell Bay of *Anemia colwellensis* and of distinctive leaf fragments described as an unknown leaf. (p. 357).

CHRONOLOGICAL REVIEW OF PLANT-BEARING BEDS AND LISTS OF ASSOCIATED PLANTS

(a) *The Upper Headon Beds*

All the plants hitherto found come from Colwell Bay where the beds present a very variable series of brown, green, greyish or variegated clays with some white sands and impure limestones. They are brackish, estuarine and freshwater deposits with an abundance of shells displaying the paucity of genera and species usual under such conditions coupled with an abundance of individuals. Among the genera are *Paludina*, *Potamomya*, *Cyrena*, *Melania*, *Limnaea*, *Potamides* and *Planorbis* (names used in the Survey Memoir now in some cases superseded). An excellent description of the section was given by Keeping & Tawney (1881) while a typical section in Colwell and Totland Bays is given in Reid & Strahan (1889: 131). This locality does not show the massive limestones found at Headon Hill (see Reid & Strahan, 1889: 129), but from

the point of view of the plants the limestone is insignificant. The sparse fruits and seeds were mostly collected between Linstone and Brambles Chine in the lowest beds of the Upper Headon Series, a laminated grey clay with *Potamomya* having a series of inconspicuous thin discontinuous fine carbonaceous seams. In addition to abundant water plants *Sequoia couttsiae* is common in places and is represented by twigs, seeds and cone scales. Among the rare land plants are seeds of *Zanthoxylum hordwellense*, *Sambucus* and the ubiquitous older Tertiary *Hordwellia eocenica*. Marsh plants are represented by various Cyperaceae and two Lythraceae. It was at this horizon that the unique fruiting specimen of *Anemia colwellensis* was obtained.

In the overlying pale-buff sands carbonaceous seams are more conspicuous but up to the present the plants found are purely aquatic, e.g. *Brasenia* and *Stratiotes*.

Below the sewer pipe at Linstone Chine there was an incoherent sandy matrix where seeds were more abundant and readily removable by washing and sifting. This was the chief source of the scarce land plants already mentioned. Water plants including *Aldrovanda* were also represented.

In folded beds north of Linstone Chine a dense black patch of seeds yielded only *Brasenia* and *Stratiotes*.

On the whole the flora so far as it is yet known is comparable with that in the more estuarine deposits of the Lower Headon but the scarcity of land plants makes comparison with the Lower Headon of little value.

Almost invariably the plants are preserved as carbonaceous entities which can be isolated from the matrix. Very frequently the cells are replaced in part or even largely by soft amorphous pyrites which is liable to smear when wet and to burst and crack when dry. Consequently the specimens are extremely difficult to preserve permanently and there is a certain amount of distension and distortion. For reasons not understood some genera are more liable to pyritization than others, e.g. *Zanthoxylum* and *Limnocarpos*. The plant list is given on p. 326.

Only about 38 species are known, including *Carpolithus* spp., not all of which are named. Twenty (including *Rhamnospermum*) appear to be marsh or water plants, *Zanthoxylum* and *Sambucus* may have grown on river banks. The conifers, always battered and broken, were probably carried down from the land behind the delta lying at a somewhat higher level together with the chance fragment of *Anemia* and the seeds of *Ficus* and *Rubus*. The Epacridaceae may well have grown on sandy flats or heath land.

The plant assemblage is not a very remarkable or informative one. *Sequoia couttsiae* and *Rhamnospermum bilobatum* are common throughout the Hampshire Basin Tertiary Beds ranging from the London Clay (unpublished record) to the Hamstead Beds and of course occurring in superabundance in the isolated upland Bovey Tracey lake basin. *Caricoidea obscura* and *Hordwellia crassisperma* have been found from the Lower Bagshot upwards. *Ficus lucidus* is also known from the Lower Bagshot and Bournemouth Freshwater Beds. *Myrica boveyana* is present in the Bournemouth Beds, the Highcliff Sands, Lower Headon of Hordle and at Bovey Tracey. *Potamogeton pygmaeus* only becomes common from the Bournemouth Marine Beds upwards to the Upper Headon and *Epacridicarpum headonense* appears first at the same horizon. *Brasenia ovula* and *Limnocarpos forbesi* on the other hand

List of Upper Headon Plants, Colwell Bay, Isle of Wight

Family	Genus and species
Pteridophyta	
Filicales	
Schizaeaceae	<i>Anemia colwellensis</i> Chandler
Gymnospermae	
Coniferales	
Araucarineae	? <i>Araucarites gurnardi</i> Florin
Taxodineae	<i>Sequoia couttsiae</i> Heer
Abietineae	<i>Pinus</i> sp.
Angiospermae	
Monocotyledones	
Potamogetonaceae	<i>Potamogeton pygmaeus</i> Chandler
	<i>Limnocarpus forbesi</i> (Heer)
Hydrocharitaceae	<i>Stratiotes headonensis</i> Chandler
Cyperaceae	<i>Carex colwellensis</i> n.sp.
	<i>Carex</i> sp.
	? <i>Scirpus</i> sp.
	<i>Caricoidea</i> (? <i>Cladium</i>) <i>colwellensis</i> n.sp.
	<i>Caricoidea maxima</i> Chandler
	? <i>Caricoidea angulata</i> Chandler
	? <i>Caricoidea obscura</i> Chandler
	Genus ?
Dicotyledones	
Myricaceae	<i>Myrica boveyana</i> (Heer)
	<i>Myrica</i> ? <i>colwellensis</i> n.sp.
Moraceae	<i>Ficus lucidus</i> Chandler
Centrospermae (Family ?)	Genus ?
Nymphaeaceae	<i>Brasenia ovula</i> (Brongniart)
	Genus ? (? <i>Brasenia ovula</i>)
	<i>Brasenia spinosa</i> Chandler
	<i>Nymphaea</i> sp.
Droseraceae	<i>Aldrovanda ovata</i> (Chandler)
Rosaceae	? <i>Rubus microsperrmus</i> C. & E. M. Reid
Rutaceae	<i>Zanthoxylum hordwellense</i> Chandler
Theaceae	<i>Hordwellia crassisperma</i> (Chandler)
Lythraceae	<i>Decodon vectensis</i> n.sp.
	? <i>Microdiptera parva</i> Chandler
Caprifoliaceae	<i>Sambucus colwellensis</i> n.sp.
Epacridaceae	<i>Epacridicarpum headonense</i> Chandler
	<i>Epacridicarpum colwellense</i> n.sp.
Family ?	<i>Rhamnospermum bilobatum</i> Chandler
Incertae Sedis	<i>Carpolithus colwellensis</i> n.sp.
	<i>Carpolithus</i> spp.
	Unknown leaf.

while appearing in the Bournemouth Marine Beds range up to the top of the Hamstead Series, although a single doubtful endocarp of the last named has been identified in Cuisian Beds at Whitecliff Bay and its endocarps are known in the Marine Beds of the Selsey peninsula at or about the horizon of the Lutetian-Auversian boundary. The former species again occurs at Bovey. *Microdiptera parva* is a species recorded from the Highcliff Sands, Lower Headon and Bovey, while *Caricoidea maxima* was first described from the Hengistbury Beds. Common to Lower and Upper Headon and scarcely as yet recorded elsewhere are *Stratiotes headonensis* (also in the highest Barton Beds), *Brasenia spinosa*, *Aldrovanda ovata* and *Zanthoxylum hordwellense*. *Rubus microspermus* is also a Bovey plant and *Araucarites* and *Anemia colwellensis* probably belong to the species recorded in the Bembridge Beds. Unique, so far, to the Upper Headon are *Carex colwellensis* and other *Carex* species. *Caricoidea* (? *Cladium*) *colwellensis*, *Myrica*? *colwellensis* (if indeed it is a *Myrica*), *Decodon vectensis*, *Sambucus colwellensis*. *Epacridicarpum colwellense* and *Carpolithus colwellensis*. These species do not appear to have any particular significance; indeed the flora as a whole agrees in a general way with the flora of the Bournemouth Marine and younger Beds, i.e. with that part of the Eocene flora from horizons where conditions of growth may have been affected by the proximity of the sea. The incoming of Hamstead and Bovey species may be noted, for *Rubus* and *Potamogeton* are both represented by other species in older beds.

(b) *The Osborne Beds*

These Beds lie between the Upper Headon Series and the Bembridge Limestone. At Headon Hill Reid & Strahan (1889: 148) list a grey shale called the "Fish and Plant Beds" but no plants have so far been traced from this locality. Between Headon Hill and Linstone Chine they state (p. 150) the Osborne Series has been removed by denudation and the cliffs consist of the underlying Headon Series. However Osborne Beds reappear beneath the battery at Cliff End at the northern end of Colwell Bay and it is this section which has yielded all but one of the few plant species here described. The section given by Reid & Strahan (1889) mentions leaves in dark shales ("Probably the equivalent of the Fish Bed" noted above).

The remains are poor and fragmentary, *Acrostichum*, *Nelumbium* and *Dicotylophyllum* having been recognized.

From the Osborne Beds at Headon a few undersized, immature and somewhat crushed and worn seeds of a *Stratiotes* have recently been obtained and referred provisionally to *Stratiotes neglectus*.

Thus the small plant list of the Osborne Series (see p. 328) contains four species up to date.

Acrostichum ranges from the Lower Bagshot throughout the Eocene where suitable sub-marine conditions prevailed and up into the Bembridge Beds. *Stratiotes neglectus*, if it is this species which is represented, is a typical Bembridge plant but has perhaps been found also in Hamstead Beds. *Nelumbium buchi* occurs at horizons both below

wer Headon) and above (Hamstead) and *Dicotylophyllum pinnatifidum* is again a Bembridge species while a fragment has been reported from the Highcliff Sands (Chandler, in press).

List of Osborne Plants, Cliff End, Colwell and Osborne, Isle of Wight

Family	Genus and species
Pteridophyta	
Filicales	
Polypodiaceae	<i>Acrostichum lanzaeanum</i> (Visiani)
Angiospermae	
Monocotyledones	
Hydrocharitaceae	? <i>Stratiotes neglectus</i> Chandler
Dicotyledones	
Nymphaeaceae	<i>Nelumbium buchi</i> Ettingshausen
Incertae Sedis	<i>Dicotylophyllum pinnatifidum</i> Reid & Chandler

According to Reid & Strahan (1889 : 157) at this horizon there is "an absence of truly marine beds . . . Purely freshwater strata are also rare. The mass of the clays seems to have been deposited in lagoons, varying in saltness, in which could live brackish-water molluscs like *Melania* and *Potamomya*, and a few of the more hardy freshwater and marine species. Lagoons of this character are at the present day favourite places for turtles and alligators, like those so abundant in this deposit." A reference then follows (p. 158) to the plants discovered by Clement Reid and Henry Keeping at Cliff End although they made no attempt at systematic collecting. The section is now overgrown and not accessible to the public.

(c) *The Bembridge Beds*

The Osborne Beds are succeeded by the Bembridge Beds, a very important member of the Oligocene fluvio-marine series of the Isle of Wight. The lower part of the Bembridge deposits is a massive limestone with shaley bands and some marly beds, the limestone being very definitely a freshwater deposit sharply divided from the mottled Osborne clays below. Although full of *Chara* it has yielded few other recognizable plant remains but Mr. J. F. Jackson obtained from a marly pocket in the limestone of Sticelett Ledge a tiny collection of fruits and seeds all of which occur in the rich Insect Limestone of the overlying Bembridge Marls with its finely preserved flora. Jackson's specimens were listed by Reid & Chandler (1926a : 378) and include the following:

- Sparganium* sp. ?
- Stratiotes neglectus* Chandler
- Cladium* sp. [*Caricoidea*]
- Brasenia ovula* (Brongniart)
- Aldrovanda* [*intermedia*]
- [*Carpolithus* sp. 2]
- [*Rhamnospermum bilobatum*]

The information in square brackets was added subsequent to the publication of the note. Only one of the species (*Carpolithus* sp. 2) has been figured and described (see p. 368, Pl. 34, figs. 162-165).

The Bembridge Marls are separated in places from the massive Limestone by some measure of erosion. They demonstrate a change in the conditions of sedimentation,

marine shells occurring at the base only. The basal beds are followed by a succession of freshwater and estuarine marls and clays. The bulk of the marls are estuarine in origin as evidenced by the fauna. Wood, fruits and seeds occur at intervals, notably seams comprising masses of *Rhamnospermum bilobatum*, *Stratiotes neglectus* or *Brasenia ovula*, other species being limited in numbers and variety (Reid & Chandler, 1926 : 3). However, the only really rich horizon, so far as present knowledge goes, is the Insect Limestone, a lenticular discontinuous band low in the Marls, a few feet only above the Bembridge Limestone proper. It is described in some detail by Reid & Chandler (1926) and in the various editions of the Geological Survey Memoir. To the information already published about the plants one or two new localities in the Bembridge Marls are now added : Wootton, Ashlake, Werror where *Stratiotes* or *Limnocarpus* or *Brasenia* only have been found (pp. 363-364, 367). There are endocarps of *Celtis* from the Bembridge Limestone of Headon Hill and fine specimens of *Carpolithus* sp. 2 have been collected in the marly pocket in the Bembridge Limestone of Sticelett Ledge mentioned above.

Apart from the above there is little to add to our knowledge of the flora. An unidentified fern (*Filix incertae sedis* sp. 5 ; Reid & Chandler, 1926 . 39) is now referred provisionally to *Anemia colwellensis* Chandler. *Araucarites gurnardi* Florin is regarded as including the cone scale formerly described as *Doliosirobium* sp. (*Araucarites gurnardi* ?) (Reid & Chandler, 1926 : 52). The pine cone described by Gardner (cf. Reid & Chandler, 1926 : 54) is now regarded as doubtfully belonging to *Pinus dixonii* (Bowerbank) and a *Potamogeton* leaf (Reid & Chandler, 1926 : 67, pl. 3, figs. 23, 24) should no longer be linked tentatively with *P. pygmaeus* as the genus is represented by more than one leaf species including the fine new but unnamed specimen found by the late G. W. Colenutt (Pl. 33, figs. 148, 149). *Epipremnum ornatum* is now referred tentatively only to this genus, a possible alternative alliance being *Raphidophora*, while *Spiromatospermum wetzleri* Heer may actually belong to *S. headonense* Chandler. *Celtis edwardsi* is an addition to the flora. The discovery by Colenutt of a finely preserved specimen has enabled the fruits formerly named *Samaravectis ovalis* to be placed in the genus *Ranunculus*. *Carpolithus actinidiformis* is almost certainly a species of *Actinidia* and has been referred tentatively to this genus but given no specific name. Hence there are altogether some 97 species listed including *Dicotylophyllum pinnatifidum* and 13 species of *Carpolithus*. Not all are named, while 15 unnamed species of *Dicotylophyllum* and an unnamed *Phyllites* (which would bring the numbers up to 113) are excluded from the number first mentioned above.

Revised list of Bembridge Plants

Excluding Charophyta. Localities as specified in systematic section.

Family	Genus and species
Pteridophyta	
Filicales	
Polypodiaceae	<i>Acrostichum lanzaeanum</i> (Visiani)
Schizaeaceae	<i>Anemia</i> sp. (? <i>A. colwellensis</i> Chandler)
	? <i>Lygodium</i> sp.
	<i>Filix Incertae Sedis</i> 5 spp.

Family	Genus and species
Hydropterideae	
Salviniaceae	<i>Azolla prisca</i> Reid & Chandler
Equisetales	
Equisetaceae	<i>Equisetum lombardianum</i> Saporta
Gymnospermae	
Coniferales	
Araucarineae	<i>Araucarites gurnardi</i> Florin
Abietineae	? <i>Pinus dixonii</i> (Bowerbank)
	<i>Pinus vectensis</i> Gardner
	<i>Pinus</i> spp. (2 species)
	<i>Pityospermum ambiguum</i> Reid & Chandler
Taxodineae	<i>Sequoia couttsiae</i> Heer
Cupressineae	<i>Cupressus</i> sp.
	? <i>Libocedrus</i> sp.
Angiospermae	
Monocotyledones	
Typhaceae	<i>Typha latissima</i> Al. Braun
Sparganiaceae	<i>Sparganium multiloculare</i> Reid & Chandler
Potamogetonaceae	<i>Potamogeton pygmaeus</i> Chandler
	<i>Potamogeton</i> sp. (formerly <i>P. pygmaeus</i> ?)
	? <i>Potamogeton</i> spp. (2 species)
	<i>Limnocarpus forbesi</i> (Heer)
	<i>Limnocarpus spinosus</i> Reid & Chandler
Najadaceae	<i>Naias oligocenica</i> Reid & Chandler
Hydrocharitaceae	<i>Ottelia britannica</i> Reid & Chandler
	<i>Stratiotes neglectus</i> Chandler
Gramineae	Genera (3 species at least)
Cyperaceae	<i>Carex gurnardi</i> Reid & Chandler
	<i>Carex</i> sp.
	<i>Cladiocarya foveolata</i> Reid & Chandler
Palmae	<i>Sabal major</i> (Unger)
	<i>Palmophyllum</i> sp.
	<i>Palaeothrinax mantelli</i> Reid & Chandler
Araceae	<i>Epipremnum</i> ? [or <i>Raphidophora</i> ?] <i>ornata</i> Reid & Chandler
Zingiberaceae	? <i>Spirematospermum wetzleri</i> (Heer) (or <i>S. headonense</i> Chandler)
	? <i>Costus</i> sp.
	Genus ?
Family ?	<i>Monocotylophyllum</i> sp.
Dicotyledones	
Juglandaceae	<i>Engelhardtia macroptera</i> (Brongniart)
	<i>Engelhardtia</i> sp.
	<i>Hooleya hermis</i> (Unger)

Family	Genus and species
Betulaceae	<i>Carpinus</i> sp.
Fagaceae	? <i>Fagus</i> sp.
	? <i>Quercus</i> sp.
Ulmaceae	<i>Celtis edwardsi</i> n.sp.
Moraceae	<i>Ficus</i> sp.
Nymphaeaceae	<i>Brasenia ovula</i> (Brongniart)
Ranunculaceae	<i>Clematis vectensis</i> Reid & Chandler
	<i>Ranunculus heterostylus</i> Reid & Chandler
	<i>Ranunculus ovaliformis</i> (Reid & Chandler)
Lauraceae	<i>Cinnamomum lanceolatum</i> (Unger)
	<i>Neolitsea</i> sp.
Cruciferae	Genus ?
Papaveraceae	<i>Papaver pictum</i> Reid & Chandler
Droseraceae	<i>Aldrovanda intermedia</i> Reid & Chandler
Rutaceae	<i>Zanthoxylum</i> (?) <i>costatum</i> Reid & Chandler
Rhamnaceae	<i>Zizyphus paradisiacus</i> (Unger) var <i>paradoxus</i>
Dilleniaceae	? <i>Actinidia</i> sp.
Apocynaceae	<i>Apocynospermum striatum</i> Reid & Chandler
	<i>Apocynospermum rostratum</i> Reid & Chandler
	<i>Apocynospermum elegans</i> Reid & Chandler
	<i>Apocynospermum dubium</i> Reid & Chandler
Asclepiadaceae	<i>Phyllanthera vectensis</i> Reid & Chandler
	<i>Tylophora antiqua</i> Reid & Chandler
Labiatae	<i>Melissa parva</i> Reid & Chandler
	<i>Ajuginucula smithi</i> Reid & Chandler
Bignoniaceae	<i>Catalpa rugosa</i> Reid & Chandler
	<i>Radermachera pulchra</i> Reid & Chandler
	<i>Incarvillea pristina</i> Reid & Chandler
Acanthaceae	<i>Acanthus rugatus</i> Reid & Chandler
Caprifoliaceae	<i>Abelia quadrialata</i> Reid & Chandler
	<i>Abelia quinquealata</i> Reid & Chandler
	<i>Abelia trialata</i> Reid & Chandler
	<i>Abelia</i> sp.4
	<i>Dipelta europaea</i> Reid & Chandler
? Compositae	Genus ?
Family ?	<i>Rhamnospermum bilobatum</i> Chandler
	<i>Flabelllicula anglica</i> Reid & Chandler
Incertae Sedis	<i>Carpolithus</i> spp.2-14
	<i>Dicotylophyllum pinnatifidum</i> Reid & Chandler
	<i>Dicotylophyllum</i> spp.2-16
	Unknown leaf (<i>Phyllites</i> sp.)

A reappraisal of this flora is now due having regard to facts and factors previously unknown or only partly recognized. As this is inevitably bound up with

general considerations relating to the Eocene floras as a whole, the study of which is now nearing completion, it seems appropriate to defer the matter until the general discussion of these floras takes place in a forthcoming volume where the results of many years of work on fruiting organs in the Tertiary floras of Southern England will be summarized.

(d) *The Hamstead Beds*

The type locality for the Hamstead Beds (spelt Hempstead in older works) is the continuous cliff section at Hamstead and Bouldnor east of Yarmouth which is usually obscured in varying degrees by slipped material. The beds actually occupy a much wider area away from the cliff face, but there are virtually no exposures and in procuring information about the outcrop the Geological Survey officers have had to depend very largely on boreholes. The Hamstead Beds are now usually divided into a lower Freshwater and Estuarine Series with lagoonal deposits which yield a fauna of turtles, crocodiles and freshwater shells together with plant remains, and an upper, much thinner, Marine Series with a few plants in laminated clay near its base. These plants are chiefly the waterlily rhizomes and leaves named *Nelumbium buchii* from the so-called Waterlily Beds and a few palm leaves. In addition, masses of *Brasenia*, *Stratiotes* and *Rhamnospermum* occur at more than one horizon in the Marine Series. There are a few other plants in the lower Estuarine Beds. A well-marked laminated carbonaceous clay called the "Black Band" has been adopted as the base of the Hamstead Beds. The separation here is in fact a matter of convenience for there appears to be no real break between the lower Hamstead Estuarine and the underlying Bembridge Estuarine Beds in spite of some evidence of weathering between the two. Indeed Reid & Strahan state (1889 : 190) "Probably if the beds were now for the first time to be sub-divided, we should class the Bembridge Marls and the greater part of the Hamstead Beds together, and separate the marine beds as the commencement of a new series formed under different conditions." Nevertheless, they continue, "though no palaeontological break occurs at the Black Band, it was so necessary to sub-divide the thick mass of clay above the Bembridge Limestone, that some marked and easily recognisable bed had to be traced. The Black Band proved to be the only horizon that could be followed, and that would give a satisfactory line from which to calculate dips and thicknesses".

Almost all of the few plants so far known are either from the bed called the "White Band" or from the Waterlily Beds. A few species, collected by Colenutt, were in slipped material from an unspecified horizon but undoubtedly above the Black Band. Some specimens in older collections are labelled Lower, or Middle, Freshwater Beds. These names originated with Forbes in the first edition of the Geological Survey Memoir (1856 : 39). Above the Black Band he subdivided the beds into a lower, middle and upper Freshwater Series with "Corbula Beds" above. He adopted the term "White Band" for a "more or less consolidated, often highly ferruginous, band of mingled broken and entire shells, forming a white line in the cliff, and a white streak among the fallen and upturned beds on the shore" (Forbes, 1856 : 43) which he regarded as the junction between his Lower and Middle Freshwater Beds. As, however, the "White Band" has proved to be discontinuous the two horizons

cannot really be separated. Moreover, Forbes' Upper Freshwater Beds pass imperceptibly into the *Corbula* Beds and form together with them a single marine division which becomes more truly marine in passing upwards, *Cerithium plicatum* dying out gradually as *Corbula* increases in abundance.

The Geological Survey Museum possesses *Rhamnospermum* and *Stratiotes* collected two feet below the White Band at Hamstead and *Brasenia* from the upper three feet of Forbes' Middle Freshwater Beds. The *Nelumbium* leaves and rhizomes of the Waterlily Bed are part impression and part actual carbonaceous substance now flaking away. *Sequoia couttsiae* may be carbonaceous entities or hollow casts in cementstone. The carbonaceous twigs if preserved in marl can be isolated by washing. This applies to the majority of plant remains which are carbonaceous fruits and seeds, but unfortunately all such are much pyritized and liable to decay. There are few but marsh or water plants known at all and virtually no information is available about the land vegetation of the period, only *Sequoia*, *Sabal*, *Rubus* and ? *Ilex* falling with any certainty into this category. The small plant list is given below. In addition Heer (1862) recorded leaves which he named *Andromeda reticulata* Ettingshausen, describing them as coriaceous and petiolate with reticulate nervation. These have not been included as the determination may need revision.

List of Hamstead Plants

Family	Genus and species
Gymnospermae	
Coniferales	
Taxodineae	<i>Sequoia couttsiae</i> Heer
Angiospermae	
Monocotyledones	
Typhaceae	<i>Typha latissima</i> Al. Braun
Sparganiaceae	? <i>Sparganium multiloculare</i> Reid & Chandler <i>Sparganium</i> sp.
Potamogetonaceae	<i>Potamogeton tenuicarpus</i> C. & E. M. Reid <i>Limnocarpus forbesi</i> (Heer)
Hydrocharitaceae	<i>Stratiotes neglectus</i> Chandler <i>Stratiotes websteri</i> (Brongniart) <i>Stratiotes acuticostatus</i> Chandler
Cyperaceae	? <i>Caricoidea minima</i> (Chandler)
Palmae	<i>Sabal major</i> (Unger)
Dicotyledones	
Nymphaeaceae	<i>Brasenia ovula</i> (Brongniart) <i>Nelumbium buchi</i> Ettingshausen
Rosaceae	<i>Rubus</i> sp.
Leguminosae	Genus ?
Droseraceae	<i>Aldrovanda intermedia</i> Reid & Chandler
Aquifoliaceae	? <i>Ilex</i> sp.
Family ?	<i>Rhamnospermum bilobatum</i> Chandler
Incertae Sedis	<i>Carpolithus</i> sp. (? <i>Spirematospermum</i> sp.) <i>Carpolithus</i> spp.

Among the Hamstead plants *Sequoia couttsiae* links the Beds with all earlier Tertiary horizons and with the Bovey Tracey lake basin further west. Its broken and battered remains suggest that it may have travelled a considerable distance. Species of *Sabal* and *Rhamnospermum bilobatum* also occur in older Tertiary beds and *Limnocarpus forbesi* in all down to at least the Bournemouth Marine stage. The water plants *Potamogeton tenuicarpus*, *Stratiotes websteri* and *Brasenia ovula* are also found at Bovey Tracey. *Typha latissima*, *Sparganium multiloculare*, *Stratiotes neglectus*, *Aldrovanda intermedia* occur in the underlying Bembridge Beds, *Caricoidea minima*, *Nelumbium buchi* in the Lower Headon of Hordle, the latter also in the Osborne Beds. *Stratiotes acuticostatus* has not yet been recorded at any other horizon.

It is clear that up to date there are virtually no characteristics known by which the flora of the Hamstead Beds can be unmistakably distinguished but the most significant species appear to be *Stratiotes websteri*, *S. acuticostatus* and *Potamogeton tenuicarpus* which here appear for the first time.

(e) *Horizon?* Locality Headon Hill (in ironstone).

Icacinaceae

Stizocarya sp.

As always my debt to others is great and I acknowledge, although inadequately, much help received from my friends and colleagues Dr. K. I. M. Chesters and Mr. F. M. Wonnacott in the preparation of this manuscript.

SYSTEMATIC DESCRIPTIONS

a) *The Upper Headon Beds*

All material from Colwell Bay, Isle of Wight.

PTERIDOPHYTA

Order FILICALES

Family SCHIZAEACEAE

Genus *ANEMIA* Swartz

Anemia colwellensis Chandler

1955 *Anemia colwellensis* Chandler, p. 304, pl. 35, figs. 39, 40, 42-53; pl. 36, figs. 59-64; text-fig. 2, 1.

The species was fully described and illustrated in the above work. The solitary pinnule fragment yielded sporangia and spores. Slides V.31519-23 were figured in 1955. There are a few unfigured slides: V.42034-35 show fragments of sporangia, V.42036 shows also fragments of annulus and paraphyses. V.42037 paraphyses, V.42033 annulus and spores. The pinnule fragment came from the lowest Upper Headon Beds between Brambles and Linstone Chines.

GYMNOSPERMAE

Order CONIFERALES

Family ARAUCARINEAE

Genus *ARAUCARITES* Presl, 1838 : 203? *Araucarites gurnardi* Florin

(Pl. 27, figs. 1, 2 ; Text-fig. 1)

1926 *Doliostrobus* sp. (*Araucarites gurnardi* ?) Reid & Chandler, p. 52, pl. 2, figs. 17, 18.

DESCRIPTION. The upper (distal) part of a broadly oval cone-scale closely comparable in form with scales from the Bembridge Beds but somewhat smaller. Length of scale incomplete ; maximum breadth (almost perfect), 6 mm. ; maximum thickness, 1.25 mm. (Length and breadth of Bembridge scales, 11 mm.) Form of base not seen ; apex with short conical mucro (? shortened by abrasion). Dorsal surface with conspicuous transverse projection about 2 mm. below the tip of the mucro, producing a facet between mucro and ridge which no doubt formed the "escutcheon" at the surface of the cone (Pl. 27, fig. 1). Ventral surface with only a slight transverse ridge



FIG. 1. ? *Araucarites gurnardi* Florin. Diagrammatic longitudinal section of a scale perpendicular to the ovuliferous surface.

about 1.25 mm. below the tip of the mucro (Pl. 27, fig. 2). Beyond the ridges the distal end of the scale is smooth on both sides. Below the ridges the surfaces are longitudinally striate. There is a smooth marginal rim at the distal end on each side of the mucro along which the cells are aligned parallel with the margin, but elsewhere in this region of the scale there appear to be longitudinally elongate cells on the dorsal surface producing longitudinal striations, but the structure is much obscured by sand-pitting. Similar longitudinal striations are particularly conspicuous on the dorsal surface over the limb of the scale below the projecting ridge. On the ventral surface the cells are transversely aligned over the ridge, but immediately below it they are equiaxial, rounded and coarse (bordered pits ?), about 0.016 to 0.025 mm. in maximum diameter. Beyond, on the limb below the ridge on this surface they are rectangular oblong, narrow and small, often sunken but with raised walls.

REMARKS. The scale (V.43780) shows the characters of Araucarineae and agrees with *Araucarites*. It so closely resembles scales from the Bembridge Beds (Reid & Chandler, 1926 : 52, pl. 2, figs. 17, 18) named *Doliostrobus* sp. (*Araucarites gurnardi* ?) that in spite of its somewhat smaller size there can be little doubt that they belong to a single species. Comparable differences in size occur among scales of living *Agathis* and *Araucaria* and in the fossil form, *Doliostrobus sternbergi* Marion (1888), the size depending on the position in the cone. The Bembridge scales were not

referred definitely to *Araucarites gurnardi* (Reid & Chandler, 1926 : 48, pl. 2, figs. 6-19) because they were not in organic continuity with the foliage so named present on the same blocks of matrix. On the grounds of generic similarity reference was made to Marion's genus *Doliostrobus* from Alais where cones and cone-scales were in organic continuity with foliage of *Araucarites* type. In the light of further experience notably with associated foliage and a cone-scale at Selsey (Chandler, 1961a : 23, pl. 4, figs. 1-5 ; pls. 5, 6) it now appears reasonable to name the Bembridge scales *Araucarites* definitely and regard them as belonging to the foliage *A. gurnardi*, the similar scale from Colwell being placed in this species also. The cone-scales of *A. gurnardi* differ both from *A. selseyensis* and *Doliostrobus sternbergi* in their less attenuated base, less elongate form and in the shorter less parallel-sided mucro although it is possible that the mucro of *A. gurnardi* may have suffered some reduction by abrasion. Further the angle of inclination of the distal margins of the scale is not so sharp as in *A. selseyensis* or *Doliostrobus*. There now appears to be little or no doubt that *Doliostrobus sternbergi* should also be regarded as an *Araucarites*.

Family TAXODINEAE

Genus *SEQUOIA* Endlicher

Sequoia couttsiae Heer

(Pl. 27, figs. 3, 4)

1962 *Sequoia couttsiae* Heer : Chandler, p. 20, pl. 4, figs. 1-32; text figs. 1-6. See also for earlier references.

Typical small twig tips which occasionally yield fragments of cuticle occur with a fair degree of frequency. They and their cuticles, also cone-scales and seeds were described and figured among material from other horizons by Chandler (1962 : 20, pls. 1-3 ; pl. 4, figs. 1-32 ; text-figs. 1-6). A few twigs bear small tufts at their extremities which appear to be male cones (V.43781-82). They are embraced by two falcate leaves the whole giving a subtriangular outline (Pl. 27, fig. 3). Within these basal leaves are branched structures with feathery extremities (slide V.44841). On maceration in nitric acid they become somewhat translucent and are seen to bear elliptical anthers with large gaping mouths (Pl. 27, fig. 4) from which pollen could be obtained. The seeds are much pyritized, frequently with a curved seed-body. Some have split marginally, as for germination, into two equal valves. The wings are commonly battered and frayed and the surface is usually rather poorly preserved. Many specimens were collected between Brambles and Linstone Chines (V.43783-84). The male cones were found between Colwell and Brambles Chines.

Family ABIETINEAE

Genus *PINUS* Linnaeus

Pinus sp.

(Pl. 27, fig. 5)

DESCRIPTION. *Seed* : Sub-obovoid, somewhat compressed and bisymmetric, apparently dehiscing for germination into two valves. One margin of the seed is

convex, the other has a sigmoidal curvature near the narrow end which gives rise to a slightly curved beak. Micropyle at tip of beak. One surface of seed perfect, flat, with narrow elongate cells arranged in parallel groups. The cell groups are variously oriented producing a complicated pattern, as in many species of *Pinus*, on the side of the seed covered by the wing, i.e. the uppermost side as it lay on the cone-scale. These cells are about 0.7 mm. long, 0.007 to 0.009 mm. broad, they show single lines of pits about 0.006 to 0.008 mm. in diameter which give a finely toothed effect where they abut against the cell walls. The ends of the cells are often rectangular. Opposite lower surface of seed convex, now incomplete, this valve has been broken longitudinally in fossilization so that two-thirds of its breadth are missing and one-third adheres to the other valve along the natural suture plane. The suture plane of the opposite margin has been exposed where the valve separated and shows cells aligned parallel with its outer edge. The broken edge of the imperfect valve is formed of broad cells about 0.076 by about 0.038 mm. aligned at right angles to the surface (seen at *c* in Pl. 27, fig. 5). Length of seed, 4.5 mm. ; breadth, 2.2 mm. ; thickness (not quite complete), 0.75 mm. Wing only preserved as a few decayed patches of tissue on the flat upper surface of the seed.

REMARKS. The form and cell structure indicate the genus *Pinus*. The living *P. breweriana* resembles it in form and size but the cell structure of the upper surface is simpler. Many species of *Pinus* show the complex arrangement of wing cells seen in the fossil. Seed (V.43785), preserved in soft pyrites mud, from between Brambles and Linstone Chines.

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family POTAMOGETONACEAE

Genus *POTAMOGETON* Linnaeus

Potamogeton pygmaeus Chandler

(Pl. 27, figs. 6-8)

1961b *Potamogeton pygmaeus* Chandler : Chandler, p. 103, pl. 24, figs. 3-6. See also for earlier references.

The species has been fully described from the Lower Headon of Hordle, Hants., and the Bembridge Beds, Isle of Wight. It is also now recorded from the Bournemouth Marine Beds and Bournemouth Freshwater Beds (one only) (Chandler, in press).

The Upper Headon of Colwell has yielded the most beautifully preserved carbonaceous endocarps yet seen, many showing the spine bases so often abraded in other material. The style, terminal on the ventral margin, is shown in Pl. 27, figs. 6, 7 and the median ventral spine in Pl. 27, fig. 6. Spine bases on keel can be seen in Pl. 27, figs. 6, 7 the long slender tips being broken. Perfect spines have only been found as impressions in the Bembridge Insect Limestone (Reid & Chandler, 1926, pl. 3, fig. 21).

The hyaline testa of the curved seed remains within the Colwell endocarps. The endocarps show externally the typical regular quadrilateral cells aligned parallel with the curvature. The great variation in size is noticeable and the slender form with large gap between the limbs is clearly visible in abraded material as the exocarp is almost invariably missing. The germination valve, crested medianly longitudinally, normally carries its spine bases but in some crushed specimens (Pl. 27, fig. 8) these are inconspicuous. These particular specimens are of unusual appearance as they are internal casts with only adherent remains of endocarp somewhat obscured by sand. Owing to compression the thickened limbs appear to lie closer together than in more normally preserved endocarps the gap between them being partly obliterated. These specimens lay on a flat bedding plane in beds with *Potamomya* and were associated with casts of Ostracods. The endocarp figured in Pl. 27, fig. 8 has been removed from its matrix. It and V.43789-91 are from beds between Brambles and Linstone Chines, V.43792 in folded beds near Fort Victoria boundary fence. The other figured specimens were below the sewer trench at Linstone Chine.

Genus **LIMNOCARPUS** Reid emend. Reid & Chandler, 1926 : 68

***Limnocarpus forbesi* (Heer)**

(Pl. 27, figs. 9, 10)

1961a *Limnocarpus forbesi* (Heer) : Chandler, p. 28, pl. 7, figs. 22-24. See also for earlier references.

1961b *Limnocarpus forbesi* (Heer) : Chandler, p. 104, pl. 24, figs. 7-11.

Endocarps of this species are among the common plants of the Upper Headon Beds. The specimens are exactly comparable in character with those from the Lower Headon at Hordle and there is nothing to add to previously published descriptions of the species. However, unlike the Hordle specimens, the Colwell endocarps are commonly pyritized in the same manner as are the *Zanthoxyleae* (p. 349). The soft amorphous pyrites has replaced the carbonaceous tissues, reproducing their form exactly, but it readily smears and on drying expands and cracks with resulting disintegration of the specimens. As at Hordle these water plants must have formed dense masses probably of floating weed growing in lagoons and stagnant channels of water. In addition to the figured specimens there are V.43796-97 from beds between Brambles and Linstone Chines and V.43798 from folded beds near the Fort Victoria boundary fence. Also 52898 Toulmin Smith Coll. 1877 "shale bed with seeds" which may be Upper or Lower Headon.

Szafer (1961 : 172, pl. 22, figs. 16-21) has recently described a *Ruppia* (*R. maritima* L. var. *miocaenica*) with a strongly papillate or rugose surface from the Miocene flora of Stare Gliwice, Poland. It bears some resemblance to *Limnocarpus forbesi* but is clearly a *Ruppia* rather than a *Limnocarpus*. He regards it as differing only from the living *Ruppia maritima* in its more papillate fruits. In the same work (1961 : 174, pl. 22, figs. 23-26) he also described a larger slightly papillate species *Ruppia major*. He considers it to be related to *Limnocarpus*. If so it is more closely akin to *L. ? enormis* (Chandler, 1961a : 29, pl. 7, figs. 25-33) than to *L. forbesi*, but *L. ? enormis* is even larger and belongs to *Limnocarpus* rather than to *Ruppia*.

Family HYDROCHARITACEAE

Genus *STRATIOTES* Linnaeus*Stratiotes headonensis* Chandler

(Pl. 27, figs. 11-19)

1961*b* *Stratiotes headonensis* Chandler : Chandler, p. 104, pl. 24, fig. 17. See also for earlier references.

The species has been so fully described in 1923 and 1961*b* that it is unnecessary to repeat the information which is equally applicable to the new material from the Upper Headon of Colwell. Thus *Stratiotes headonensis* now ranges from the top of the Barton Beds to the Upper Headon. Typical Upper Headon specimens are illustrated (Pl. 27, figs. 11-14) while seeds from the Lower Headon of Hordle are figured for comparison (Pl. 27, figs. 16-19). In addition to figured Colwell material there are V.43804 from beds between Brambles and Linstone Chines ; V.43805 in sand and clay south of Linstone Chine above the Oyster Bed ; V.43806 from folded beds close to Fort Victoria boundary fence. One box of seeds labelled " Bembridge Series " certainly belongs to *S. headonensis* but is probably from Colwell.

Family CYPERACEAE

Genus *CAREX* (Dill.) L.*Carex colwellensis* n.sp.

(Pl. 28, figs. 26, 27)

DIAGNOSIS. Endocarp triangular with obovate facets, of which the greatest breadth lay at about the middle. Surface cells with raised walls and central papillae. Length of cells variable, some equiaxial, breadth from 0.01 to 0.016 mm. Length of endocarp, 1.5 mm. ; breadth, 0.75 by 0.5 mm.

HOLOTYPE. V.43808.

DESCRIPTION. *Endocarp* : Three-angled, three-sided, each facet being obovate. One facet somewhat narrower than the other two. Greatest breadth at about the middle. Style patent very shortly trifid (worn). Splitting tends to occur along the angles starting at the base. Surface formed of somewhat elongate cells with slightly raised walls some of which show remains of a raised central papilla. Margins of cells very finely toothed. Length of cells variable some being equiaxial, breadth about 0.016 mm. at the middle of the endocarp, 0.01 mm. near the apex. Length of endocarp 1.5 mm. including style base ; breadth, 0.75 by 0.5 mm.

REMARKS. A typical triangular *Carex*. The most comparable living species seen were *Carex flava* and *C. oederi*, both of which have smaller and more rounded surface cells. The solitary specimen is so beautifully preserved as to be " recent " in appearance but its pyritized condition established it as a genuine fossil. Round black patches on the surface suggest pustules due to fungus. From beds between Brambles and Linstone Chines.

Carex sp.

(Pl. 28, figs. 20-25)

DESCRIPTION. *Endocarp*: Obovate in outline with one surface flat and the other slightly inflated at the middle with an obscure median longitudinal angle flanked by two facets. All now much compressed so as to be nearly flat. The greatest breadth is at about three-quarters of the length from the base. Apex rounded, style obscure (? due to abrasion). Surface formed of polygonal or hexagonal, somewhat elongate, longitudinally aligned cells about 0.016 to 0.025 mm. broad. The cells have slightly raised walls. One perfect endocarp was 1.3 mm. long, 0.8 mm. broad. Another endocarp (slightly imperfect at the base) was 1.3 mm. long, 0.75 mm. broad. Only one (V.43807) is still extant owing to their poor condition on discovery. All from beds between Brambles and Linstone Chines.

Genus *SCIRPUS* (Tourn.) L.? *Scirpus* sp.

(Pl. 28, fig. 28)

DESCRIPTION. *Endocarp*: Obovate, somewhat truncate at the base where there is a large aperture. Apex with stout stylar mucro about 0.2 mm. long. Surface ornamented with about six rounded longitudinal ribs separated by deep sharp furrows. Coat forming ribs spongy, close-textured, of very minute cells having a tendency to produce transverse striations. Basal aperture closed by a small circular plug convex externally at its centre from which small cells radiate. Length of endocarp, 2 mm. ; breadth, 1 mm.

REMARKS. The near relationship of this unique specimen (V.43809) has not been conclusively established but it probably belongs to the group Caricoideae, or to Scirpoideae and perhaps to *Scirpus* as suggested by the basal aperture with plug and the apical mucro. It is quite distinct in the form of its rounded longitudinal ribs from *Scirpus lakensis* (Chandler, 1962 : 50, pl. 6, figs. 7-18) from the Lower Bagshot and Bournemouth Freshwater Beds and from Cuisian Beds in the Selsey Peninsula (Chandler, 1961a : 18, 33).

Genus *CARICOIDEA* Chandler, 1957 : 86*Caricoidea* (?*Cladium*) *colwellensis* n.sp.

(Pl. 28, figs. 31-35)

DIAGNOSIS. More or less bisymmetric oburceolate endocarp resembling *Cladium* in form but having a plate-like expansion at the base of the neck, sometimes split radially in line with two longitudinal ridges in the plane of symmetry. Surface with irregular low rugosities. Length of endocarp, 1.5 to 2.25 mm. ; breadth, 1 to 1.75 mm.

HOLOTYPE. V.43810.

DESCRIPTION. *Endocarp*: Oburceolate with marked apical mucro, conspicuous contracted neck spreading out below to form a circular plate-like base often broader than the endocarp itself. Approximately bisymmetric with rounded longitudinal

ridges extending from the mucro in the plane of symmetry on each side to the edge of the neck. Plate-like base sometimes indented or split radially along the line of these ridges forming in such specimens a pair of basal flanges rather than a plate (Pl. 28, figs. 32, 34). Surface of endocarp covered with irregular low rugosities. Basal aperture small (Pl. 28, fig. 35). Rugose outer coat, about 0.15 to 0.2 mm. thick, formed of spongy hollow cells about 0.025 mm. in diameter. In section a thin coarsely columnar inner coat is seen about 0.025 mm. thick. Cavity lined by transversely oriented cells (testa of seed ?) which are finely toothed, the narrower diameter from top to bottom being about 0.016 mm. There is also a longitudinally striate layer with cell walls (striae) about 0.016 mm. apart. Dimensions of endocarps : 1) Length, 1.7 mm. ; breadth, 1.5 mm. ; breadth of neck, 1.2 mm. 2) Length, 1.75 mm. ; breadth, 1 mm. ; breadth of neck, 1.2 mm. 3) Length, 1.5 mm. ; breadth, 1.15 mm. ; breadth of neck, 1.5 mm. 4) Length, 1.5 mm. ; breadth, 1 mm. ; breadth of neck, 1.1 mm. 5) Length, 1.75 mm. ; breadth, 1.25 mm. 6) One exceptionally large endocarp length, 2.25 mm. ; breadth, 1.75 mm. ; breadth of neck, 1.75 mm.

REMARKS. The fruit (utricle) has not been seen. The endocarps obviously belong to Caricoideae and are closely related to and probably identical with *Cladium*. They differ from living representatives of this genus so far seen and from comparable fossil species in the irregular rugosities of the external surface and in the plate-like basal expansion of the neck. One specimen (now decayed) showed the basal expansion seated on a pillow-like receptacle. An expansion was present in a lesser degree in specimens from the Pliocene of Bidart (C. & E. M. Reid, 1915 : 424, pl. 7, fig. 30) and is developed in a peculiar way as a wide pierced plate with large foramina in *Cladium reidiorum* Nikitin (*in* Dorofeev, 1958 : 172, pl. 1, fig. 33 from the Oligocene of Western Siberia ; 1959 : 168, pl. 3, figs. 9-11, from the Miocene of the Rostov Region) and in a slightly lesser degree in *Cladium macrocarpum* Dorofeev and *C. europaeum* Dorofeev from the Tertiary of Byelorussia (Dorofeev, 1960 : 1428, pl. 3, figs. 7-12). The apical mucro is very well developed also the longitudinal ribs. While therefore they may belong to *Cladium* it seems better until information about the fruit is forthcoming to refer them only provisionally to *Cladium* leaving them for the present in the form-genus *Caricoidea*.

Szafer (1961 : 90, pl. 24, figs. 17-23) refers endocarps of this type without hesitation to *Cladium mariscus* R.Br., *foss.* They came from the Miocene of Stare Gliwice, Poland.

In addition to the figured material there are V.43813-14. All were found between Brambles and Limestone Chines. One endocarp (decayed) was from the folded beds near the Fort Victoria boundary fence.

Caricoidea maxima Chandler

(Pl. 28, figs. 36-40)

1960 *Caricoidea maxima* Chandler, p. 207, pl. 31, fig. 35.

EMENDED DIAGNOSIS. Fruit obovoid or truncate subovoid with deep depression in the truncate base. Length of fruit, 3.2 to 4.25 mm. ; greatest breadth, 2.25 to 3.25 mm. Endocarp subglobular or shortly oburceolate, with or without apical mucro,

with short basal neck and two opposite longitudinal ridges. Length of endocarp, 1.5 to 2 mm.; breadth, 1.4 to 2 mm.

SYNTYPE. V.43815.

DESCRIPTION. *Fruit*: Obovoid to truncate subovoid frequently somewhat flattened laterally, with basal truncation which is pierced by a large subcircular or circular opening. Obtusely pointed at the apex. Surface always abraded as no specimen has been seen showing the outer shining epidermal layer. Wall woody, up to at least 0.6 or 0.7 mm. thick, close-textured, formed of equiaxial cells about 0.022 mm. in diameter. Length of fruit, 3.2 to 4.25 mm.; greatest breadth, 2.25 to 3.25 mm.

Endocarp: Usually situated nearer to the apex than the base within the thick woody fruit. Shortly oburceolate or subglobular sometimes with small apical mucro. Basal aperture with neck which may be very short and is closed by a plug. Aperture opening into a short canal in the fruit wall leading to its basal opening. Surface close-textured, finely pitted, pits 0.012 to 0.016 mm. in diameter, with two longitudinal opposite external ridges. Formed, as seen in section, of a thin outer layer with obscure structure and an inner columnar coat which is about 0.23 mm. thick. Lining layers much decayed but showing traces of horizontally aligned digitate cells. Length of endocarp, 1.5 to 2.2 mm.; breadth, 1.4 to 2 mm.

REMARKS. One fruit and two detached endocarps, all figured. Two other figured specimens have now decayed. The species was based on a fruit from the Hengistbury Beds (reference given above), but information about the endocarp is now available for the first time. The diagnosis is therefore expanded. *Caricoidea maxima* resembles *C. minima* from the Lower Headon of Hordle, but the fruit is considerably larger and the endocarp is larger and more subglobular. It may also be present at Hordle as a similar specimen was seen there, but unfortunately it decayed before it could be described.

? *Caricoidea angulata* Chandler

(Pl. 28, figs. 41, 42)

Caricoidea angulata Chandler (in press), p. 66, pl. 9, figs. 1-23; text-fig. 12.

DESCRIPTION. *Fruit*: Not seen.

Endocarp: Detached from fruits. Body of endocarp narrowing gradually or more suddenly to form a basal neck, apex narrowed to a mucro, well marked in some better preserved specimens (Pl. 28, fig. 41) abraded in others (Pl. 28, fig. 42). Surface abrasion makes it difficult to see the regular even pitting characteristic of *Caricoidea angulata*. Dimensions of endocarps: 1) Length, 1.5 mm.; breadth, 1.25 mm. 2) Length, 1.7 mm.; breadth, 1.3 mm. 3) Length, 1.75 mm.; breadth, 1.3 mm.

REMARKS. In addition to two figured specimens, there are V.43820-23 all from between Brambles and Linstone Chines. In the absence of evidence about the fruit and in view of the abraded condition the determination of the species is provisional, but the size agrees with that of *C. angulata* and the endocarps are smaller than those of *C. maxima* and larger than those of *C. obscura*.

? *Caricoidea obscura* Chandler

(Pl. 28, figs. 29, 30)

1960 *Caricoidea obscura* Chandler, pp. 207, 223, pl. 30, figs. 27-33 ; pl. 33, figs. 98-105.

1961a *Caricoidea obscura* Chandler : Chandler, p. 33, pl. 7, fig. 34.

1961b *Caricoidea obscura* Chandler : Chandler, p. 106, pl. 24, figs. 22-24.

1962 *Caricoidea obscura* Chandler : Chandler, p. 52, pl. 6, figs 20-33 ; text-fig. 9.

Caricoidea obscura Chandler : Chandler (in press), p. 65, pl. 8, figs. 42-56.

DESCRIPTION. *Endocarp* : Oburceolate narrowing gradually to a mucronate apex and contracting suddenly to a narrow basal neck. Some specimens show a pair of longitudinal ribs. Outer surface smooth (although sometimes rough secondarily through decay in fossilization) showing traces of very fine cells and pitting. Wall in section about 0.1 mm. Locule lining obscure. Dimensions of endocarps : 1) Length, 1.25 mm. ; breadth, 1.05 mm. 2) Length, 0.9 mm. ; breadth, 0.8 mm. 3) Length, 1 mm. ; breadth, 0.9 mm. 4) Length, 1 mm. ; breadth, 0.8 mm. 5) Length, 0.9 mm. ; breadth, 0.75 mm.

REMARKS. The small size of these isolated endocarps suggests *Caricoidea obscura* but as the fruits have not been seen the determination is provisional. Endocarps from the Lower Headon of Hordle are equally small. Those from the Lower Bagshot are slightly larger. The Highcliff Sands specimens are closely comparable in size although some are relatively broader. In addition to two figured endocarps there are V.43825 and V.43827, all from between Brambles and Linstone Chines and V.43828 an endocarp in folded beds close to Fort Victoria boundary fence.

Family CYPERACEAE

Genus ?

(Pl. 28, figs. 43, 44)

DESCRIPTION. *Fruit* : Rounded elongate triangular in outline, apex broken, sides tapering gradually to the base which is somewhat blunt. Probably originally more or less pointed at the apex. The fruit may have been triangular in transverse section with one broad facet occupying the whole breadth and two narrow ones meeting in a longitudinal angle having a groove along its crest. External surface longitudinally striate, between the striae are lines of equiaxial cells about 0.01 mm. in diameter. Internal surface where exposed by splitting on drying showing conspicuous transverse alignment of cells. Length of fruit, 2.2 mm. ; breadth, 1.1 mm. No endocarp has been seen.

REMARKS. Cell structure and form suggest Cyperaceae and possibly *Carex* but in view of the poor condition and the fact that there is only one specimen (V.43829) it appears inadvisable to make more than a tentative reference to the family.

V.43830 is a small triangular endocarp belonging to the family Cyperaceae but it is unlike other species described.

Class DICOTYLEDONES

Family MYRICACEAE

Genus *MYRICA* Linnaeus*Myrica boveyana* (Heer) pars

(Pl. 29, figs. 45-48)

1862a *Carpolithus boveyanus* Heer, p. 1077, pl. 70, figs. 7-14 (in part).1957 *Myrica boveyana* (Heer) pars Chandler, p. 90, pl. 12, figs. 45-48.1961b *Myrica boveyana* (Heer) pars : Chandler, p. 110, pl. 25, figs. 33, 34.

DESCRIPTION. *Endocarp* : Bisymmetric, germinating by splitting into equal valves in the plane of symmetry, oval in outline, somewhat compressed at right angles to the plane of symmetry. Outer surface with obscure rugosities over the central area, very slightly flattened around the margin. A few superficial fibres have a general longitudinal arrangement, some appear to enter the thickness of the endocarp near a small basal scar. Locule, as revealed on inner surface of valve after germination, urceolate in outline tapering into an apical stylar canal; suture about 0.6 mm. broad, flat. Base with short funicular canal still carrying a fibre. Cells of locule lining diverge from style and funicle; locule longitudinally striate, the striae due to elongate polygonal cells which appear to have finely toothed walls, largest at the middle of the endocarp where they may be 0.05 mm. long and 0.027 mm. broad. Length of endocarp, 3.75 mm.; breadth, 3.1 mm.; thickness, 2.25 mm. Second specimen (represented by one, slightly imperfect, much abraded valve): length, 3.25 mm.; breadth, 2.75 mm.; thickness (estimated), 2 mm. Small endocarp: length, 2.5 mm.; breadth, 1.75 mm. (V.43833).

REMARKS. The endocarps are comparable with those from Bovey Tracey but are larger than the Hordle specimens. From between Brambles and Linstone Chines.

Myrica? colwellensis n.sp.

(Pl. 29, figs. 49-55)

DIAGNOSIS. Endocarp subovoid with about six regular low rounded external longitudinal ribs on each valve separated by sharp furrows which carry fibres. Length of endocarp about 2.8 to 3 mm.; breadth about 2 to 2.5 mm.

HOLOTYPE. V.43834.

DESCRIPTION. *Endocarp* : Bisymmetric, germinating by splitting into two valves in plane of symmetry. Subovoid but somewhat compressed at right angles to the plane of symmetry, having a slight basal mucro and evenly rounded apex. External surface with about six regular low rounded ribs on each valve with a longitudinal fibre in each of the sharp furrows between them. The fibres extend almost from the basal attachment scar to the apical style. Locule compressed urceolate, narrowed to the stylar canal, having a short funicular canal at the base. Suture plane 0.4 to 0.5 mm. broad near the base. Locule lining of finely toothed more or less equiaxial cells about 0.05 mm. in diameter. Texture of wall compact. Length of endocarp, 2.8 mm.; breadth, 2 mm.

REMARKS. The holotype is represented by its two separated valves one slightly imperfect. There is also a single abraded valve of another slightly larger specimen (V.43836) and the basal end of one valve of a third broader endocarp (V.43835), V.43837 is a broken and unfigured valve. The reference of this species to *Myrica* must be regarded as doubtful, but on the whole the resemblance is greater than to *Carpinus* which has a similar compressed urceolate locule. *Carpinus* may show uneven fluting of the surface as in *C. betulus* but not regularly longitudinal lobing, while the well marked fibres always overlie longitudinal ridges not the intervening furrows as in the fossil. The form of the endocarp in *Carpinus* is pointed ovate not a regular oval in outline. All specimens are shrunken and diminished in size through drying. Position of placenta not clear.

Family MORACEAE

Genus *FICUS* Tourn.

Ficus lucidus Chandler

(Pl. 29, fig. 56)

1962 *Ficus lucidus* Chandler, p. 58, pl. 7, figs. 13-18; text-fig. 11.

Ficus lucidus Chandler: Chandler (in press), p. 76, pl. 11, figs. 13-15.

DESCRIPTION. *Carpel*: Subovoid originally, now crushed, both diameters being increased thereby. The carpel has burst and split marginally at the stylar end. Surface formed of minute equiaxial cells. Length, 1.5 mm.; breadth, 1.25 mm. as crushed.

REMARKS. The single specimen (V.43838) from beds between Brambles and Linstone Chines is identical in general morphological characters and cell structure with better preserved material from the Dorset Pipe-clay Series and the Bournemouth Beds (references above).

Order CENTROSPERMAE

Family ?

Genus ?

(Pl. 29, fig. 57)

DESCRIPTION. *Seed*: Small curved, transversely oval in outline, with asymmetrically placed marginal hilum between the unequal limbs marked by a small projection. Surface smooth apparently formed of somewhat obscure digitate cells with few digitations, the cells about 0.027 mm. in diameter. Dimensions of seed, 0.9 by 0.75 mm.

REMARKS. The form and digitate cells suggest Centrospermae, possibly even Caryophyllaceae, but the material is too poor and limited for further determination. The seed has begun to split starting at the hilum and in a direction between the limbs. The solitary specimen, V.43839 came from beds between Brambles and Linstone Chines.

Family NYMPHAEACEAE

Genus *BRASENIA* Schreber*Brasenia ovula* (Brongniart)

(Pl. 29, figs. 58, 59)

1926 *Brasenia ovula* (Brongniart) Reid & Chandler, p. 99, pl. 6, figs. 15-18. See also for earlier references.1957 *Brasenia ovula* (Brongniart) : Chandler, p. 96, pl. 13, fig. 75.1961b *Brasenia ovula* (Brongniart) : Chandler, p. 116.

The species is one of the commonest plants in the Lower Headon of Hordle and the Isle of Wight and successive beds of the Oligocene in the Isle of Wight and at Bovey Tracey. It usually occurs in seams blackened by its seeds and some of the seed-beds mentioned by Reid & Strahan (1889) are made up almost exclusively of these seeds. As in all localities where *Brasenia ovula* occurs there is very great variation in shape and size. The species is too well known for further description to be necessary as all previous accounts are equally applicable to the Upper Headon material. In addition to figured material which comes from beds south of Brambles Chine, there are seeds from between Brambles and Linstone Chines (V.43842) and from folded beds close to Fort Victoria boundary fence (V.43843).

Genus ? (?*Brasenia ovula*)

(Pl. 29, fig. 62)

DESCRIPTION. *Seed* : Crushed dorsiventrally so that the original form is obscured but the slightly conical embryotega is clearly seen with its central micropylar aperture. The embryotega is about 0.6 mm. in diameter. Its limits as it lies in the testa are rather obscure since it has not begun to separate from the surrounding tissues. Its cells are radially aligned around the central aperture, largest at the circumference where they are about 0.05 mm. in diameter, convex with rounded outlines having a slight tendency only to be sinuous. Surface of seed itself formed of digitate cells like those of *Brasenia ovula* with few (about five or six) digitations which are short and rounded. Each cell is somewhat convex superficially and the alignment is in longitudinal rows diverging from the embryotega. The cells show signs of separating from each other perhaps as a result of crushing. They are coarser than those of typical *B. ovula* and more inflated, the larger ones about 0.1 mm. in diameter. Tegmen translucent. Diameter of crushed seed, 3 by 2.6 mm.

REMARKS. The large seed falls within the range of size of *Brasenia ovula*. Its peculiar appearance may be the result of crushing, but it has been related to this species only provisionally. V.43852 from between Brambles and Linstone Chines.

Brasenia spinosa Chandler

(Pl. 30, figs. 63-69)

1961b *Brasenia spinosa* Chandler : Chandler, p. 117. See also for earlier references.

DESCRIPTION. *Seed* : Subglobular to ovoid, anatropous with circular aperture at one end, often gaping but sometimes closed by an embryotega. External surface

with rounded longitudinal ridges sometimes corresponding with lines of cells and with rows of sporadic tubercles which may be blunt, short and rounded or longer and spiny. They are frequently broken. Tubercles may arise from the centre of a digitate cell 0.05 to 0.1 mm. in diameter although not every cell bears a tubercle. Sometimes the tubercles or rugosities are not related to the cell outlines but cover several cells. The longitudinal ridges may be partly the result of contraction on drying. Testa tending to break along the digitate outlines. A more conspicuous rounded longitudinal ridge marks the raphe. Testa about 0.15 mm. thick in section. The embryotega is convex externally with large median rimmed micropyle. It is formed of rectangular or square thick walled cells which sometimes appear slightly sinuous. They are about 0.05 mm. in diameter. Tegmen thin, translucent, yellowish finely striate. Dimensions: Length, 1.25 to 2.5 mm.; breadth, 1 to 2 mm.

REMARKS. The Upper Headon specimens fall approximately within the range of size of *Brasenia spinosa* from the Lower Headon of Hordle, a few seeds of which are here shown for comparison (Pl. 30, figs. 64, 65, 67-69). Those in figs. 67-69 are small specimens with coarse tubercles which were originally separated as a distinct species *B. antiqua*. However, it later appeared that the two varieties, one with spiny tubercles, the other with short thick tubercles graded into one another so that they could not be separated (Chandler, 1961b: 117). On the whole the Lower Headon seeds tend to be smaller. Thus dimensions of *B. spinosa* from Hordle were originally given as 1.5 by 1.5 mm. and of *B. antiqua* as 1 by 0.75 to 1 mm. Recent measurements of Hordle seeds give length, 1 to 2.25 mm.; breadth, 2.25 by 2.25 mm. In addition to figured material there are V.43846-47, V.43849 from between Brambles and Linstone Chines and V.43848 from south of Linstone Chine.

Genus *NYMPHAEA* (Tourn.) L.

Nymphaea sp.

(Pl. 29, figs. 60, 61)

DESCRIPTION. *Seed*: Ellipsoid, very slightly truncate at the hilar end where the burst aperture for a small embryotega can be seen. Embryotega present but obscure in V.43850, the aperture not more than 0.3 to 0.4 mm. in diameter. Anatropous, the longitudinal raphe forming a slight ridge from base to apex. Surface of seed obscurely longitudinally ridged, the ridges lying along the junctions of longitudinal rows of digitate cells with interlocking claws which may be lobed or forked at their extremities. These cells, which are also aligned in distinct transverse rows, are often transversely elongate but sometimes equiaxial. They are about 0.05 to 0.15 mm. in diameter. The hilar end of the seed around the embryotegal aperture has distinct radially arranged crumples. A few fine sharply pointed tubercles are seen along the ridges closely adpressed to the surface. Length of seed, 2.75 mm.; breadth, 1.25 to 1.5 mm.

REMARKS. The two figured specimens are the actual carbonaceous seeds themselves. An internal cast in pyrites of a third specimen has now decayed. On it the regularly arranged digitate cells were formerly beautifully preserved as impressions with shorter, more rounded swollen-ended digitations. The whole surface of the pyrites cast also showed rounded cells about 0.008 mm. in diameter, perhaps the

replacement of albumen cells. The elliptical aperture from which the embryotega had disappeared was represented by an impression with maximum diameter of about 0.03 mm. There is some resemblance to *Brasenia oblonga* Chandler from the Lower Headon of Hordle but these Colwell seeds have a more ellipsoid form, larger size and less regular tubercles. Form and arrangement of the surface cells appear to ally them with *Nymphaea*.

Family DROSERACEAE

Genus *ALDROVANDA* (Monti) L.

Aldrovanda ovata (Chandler)

(Pl. 30, figs. 70, 71)

1961b *Aldrovanda ovata* (Chandler) : Chandler, p. 119, pl. 26, figs. 53-55. See also for earlier references.

DESCRIPTION. *Seed* : Oburceolate with a narrow neck about one-sixth to one-seventh of the length of the whole seed, closed by a circular plug having a central thick short mucro from which the small convex equiaxial cells of its outer surface radiate. Anatropous with conspicuous longitudinal raphe ridge terminating in a marked mucro at the apex over the chalaza at one end and in the basal hilum on the margin of the neck at the other. Surface black, shining, testa formed of two coats, an outer coat 0.05 to 0.1 mm. thick, of radially arranged cells as seen in section whose slightly inflated outer ends give rise to flat or scarcely convex equiaxial cells about 0.001 mm. in diameter on the external surface. On the internal surface there are cells about 0.002 to 0.003 mm. in diameter. An inner coat, 0.15 mm. thick is formed by a single layer of radially arranged prismatic cells about 0.02 to 0.05 mm. in diameter. Dimensions of several seeds : 1) Length, 1.75 mm. ; breadth, 1.35 mm. ; length of neck, 0.25 mm. 2) Length, 1.76 mm. ; breadth, 1.4 mm. ; length of neck, 0.3 mm. 3) Length, 1.9 mm. ; breadth, 1.25 mm. ; length of neck, 0.25 mm. 4) Length, 2 mm. ; breadth, 1.25 mm. ; length of neck 0.25 mm. 5) Length, 1.75 mm. ; breadth, 1.25 mm. ; length of neck, 0.25 mm. 6) Length, 2 mm. ; breadth, 1.25 mm. ; length of neck about 0.3 mm. Average length of seeds, 1.83 mm. ; average breadth, 1.28 mm.

REMARKS AND AFFINITIES. About a dozen seeds and some fragments. They agree in every respect with *Aldrovanda ovata* (Chandler) from the Lower Headon of Hordle (Chandler, 1925 : 22, pl. 3, fig. 3a, b ; Reid & Chandler, 1926 : 113, pl. 4, figs. 24-26) in their large size, conspicuous apical mucro and marked raphe ridge, relatively long neck and smooth surface and thick testa, the two coats of which together measure nearly a quarter of the diameter of the seed. The characters which distinguish this species from *A. intermedia* Reid & Chandler (Bembridge and Hempstead) and *A. vesiculosa* L. (Recent) were discussed by Reid & Chandler (1926 : 111-113). In addition to figured material there is V.43855, all from below the sewer pipe, Linstone Chine, also V.43856-57 from between Brambles and Linstone Chines, and V.43858 in folded beds close to Fort Victoria boundary fence.

Family ROSACEAE

Genus *RUBUS* (Tourn.) L.? *Rubus microspermus* C. & E. M. Reid

(Pl. 30, figs. 72, 73)

1910 *Rubus microspermum* C. & E. M. Reid, p. 169, pl. 15, figs. 13-17.1957 *Rubus microspermus* C. & E. M. Reid : Chandler, p. 101, p. 14, figs. 100-109.

DESCRIPTION. *Endocarp* : Laterally compressed, semicircular to narrow-ovate in outline ; ventral margin concave, straight or slightly convex, dorsal margin semicircular or markedly convex. Base rounded. Apex sometimes narrower than base, sometimes curved towards the ventral side, margin rimmed all round. Surface reticulate with conspicuous angular pits separated (in unworn specimens) by clearly defined ridges. Dimensions of several endocarps are as follows : 1) Length, 2.9 mm. when moist, 2.85 mm. after drying and shrinkage ; breadth, 1.25 mm (moist), 1.2 mm. (dry). 2) Length, 2.25 mm. (moist), 2 mm. (dry) ; breadth, 1.3 mm. (moist), 1.25 mm. (dry). 3) Length of much abraded hooked endocarp, 2.1 mm. ; breadth, 1.1 mm.

REMARKS. These endocarps agree, so far as they are known, with *Rubus microspermus* from Bovey Tracey but they appear to be larger on the whole. They are less narrow and pointed at the apex than *R. acutiformis* from the Dorset Pipe-clay Series at Studland, the Bournemouth Freshwater Beds of Branksome Dene and the Lower Headon of Hordle. *R. acutiformis*, dry, measures 1.55 by 1.2 mm. ; 2 by 1.25 mm. ; 1.5 by 1 mm. The dimensions when wet were 2 to 2.25 by 1.3 mm. Typical Bovey specimens of *R. microspermus* dry measure 2.1 by 1.25 mm. ; 2.25 by 1 mm. ; 2 by 1.25 mm.

In the absence of a larger range of material showing variations of size and form the Colwell species is referred provisionally only to *R. microspermus*. In addition to the figured specimens from below the sewer trench, Linstone Chine, there are endocarps V.43861 from beds between Brambles and Linstone Chines, only one now complete.

Family RUTACEAE

Genus *ZANTHOXYLUM* Linnaeus*Zanthoxylum hordwellense* Chandler

(Pl. 30, figs. 74-80)

1925 *Zanthoxylon* cf. *ailanthoides* Sieb. & Zucc. Chandler, p. 26, pl. 4, fig. 3a, b; text-fig. 9.1961b *Zanthoxylum hordwellense* Chandler, p. 123, pl. 26, figs. 63, 64.

DESCRIPTION. *Seed* : Semianatropous, approximately semicircular or gibbous to subcircular in outline with ventral margin very slightly convex, dorsal rounded. Somewhat flattened laterally so as to give a sublenticular outline in transverse section. Ventral margin with an elongate narrow triangular depressed hilar scar occupying from half to three-quarters of the length in the upper part. There is a tendency for it to be somewhat asymmetric and slightly curved. Hilar aperture at the base of this scar leading into raphe canal which extends within to the internal

chalaza and causes the slight prominence in the lower part of the ventral margin. Chalaza large about 0.3 mm. in diameter, lying on the ventral side of the longest axis of the seed. Testa thick, concentric wrinkles present but somewhat obscured by abrasion, formed of equiaxial cells arranged so as to give a columnar appearance in section. Cells on external surface crenulate or finely sinuous. On the internal surface they are about 0.016 mm. in diameter. Tegmen or inner integument thin, papery, semi-translucent, light brown in colour, formed of equiaxial cells 0.01 to 0.025 mm. in diameter smallest at the chalaza and at the opposite pole of the seed. Typical seed measurements: 1) Length, 3.5 mm.; breadth, 3 mm.; thickness, 2.75 mm. Length of hilar scar, 3 mm. 2) Length, 3 mm.; breadth, 2.75 mm. 3) Length, 4.5 mm.; breadth, 3 mm.; thickness, 2.75 mm. Length of hilar scar, 2.5 mm. Seed somewhat distorted in growth. 4) Length, 2.25 mm.; breadth, 2.25 mm. 5) Length, 3.25 mm.; breadth, 3.25 mm.

REMARKS. The seeds are not uncommon between Brambles and Linstone Chines. In addition to figured material from this site there are also V.43866-67 from folded beds close to the Fort Victoria boundary. The last mentioned apparently an internal cast with thick testa gone, perhaps immature. They agree in size and characters with the specimens from the Lower Headon of Hordle, but are generally more abraded so that the superficial wrinkles are less conspicuous although still visible (Pl. 30, figs. 74, 77, 78) and the fine cells of the epicarp are not seen for the same reason. The raphe is exposed in longitudinal section and the chalaza in broken seeds. A peculiar feature is the heavy pyritization in the form of a fine soft amorphous powder or mud which does not retain clear cell impressions as it readily smears. In this respect the Colwell seeds are less well preserved than the Hordle ones and are even more liable to decay.

Family THEACEAE

Section TAONABEAE

Genus *HORDWELLIA* Chandler, 1960 : 228

Hordwellia crassisperma (Chandler)

(Pl. 30, figs. 81-85)

1961b *Hordwellia crassisperma* (Chandler) : Chandler, p. 140. See also for earlier references.

1962 *Hordwellia crassisperma* (Chandler) : Chandler, p. 112, pl. 17, figs. 8-61.

DESCRIPTION. *Fruit* : Inferior, subglobular but now much distorted dorsiventrally-oblique and flattened. Showing a small raised rim representing the persistent perianth base with three-rayed ridge inside it indicating three locules. Sepals not preserved. Surface of fruit finely pitted. Diameter about 1.25 by 1.75 mm.

Seed : Subovate to cuneate in outline, truncate at the hilar end, hilum and micropyle adjacent on the truncation as described in 1962 and earlier, varying considerably in form and size as is typical for this species. Surface pitted as described in earlier accounts, pits and inner part of wall made up of fine equiaxial cells. Typical seed measurements are as follows: 1) Length, 1.5 mm.; breadth, 1.25 mm. 2) Length,

1.85 mm. ; breadth, 1 mm. 3) Length, 1.5 mm. ; breadth, 1 mm. 4) Length, 1.25 mm. ; breadth, 1 mm. 5) Length, 1.4 mm. ; breadth, 0.8 mm. 6) Length, 1.25 mm. ; breadth, 0.8 mm. 7) Length, 1 mm. ; breadth, 0.75 mm.

REMARKS. For the geological range hitherto recorded for this species see Chandler (1962). The seed from the Upper Headon figured in Pl. 30, fig. 83 is slightly different in appearance from the normal, the external pits being unusually regular and symmetrically arranged probably due to the fact that it is preserved in pyrites and the pit walls are therefore rigid.

Family LYTHRACEAE

Genus *DECODON* J. F. Gmel.

Decodon vectensis n.sp.

(Pl. 30, figs. 86–90 ; Pl. 31, figs. 91–98)

DIAGNOSIS. Seed triangular pyramidal, edges sharply angled. Dorsal surface sharply angled over the raphe. Outer surface of germination valve somewhat concave. Outer woody compact coat of testa much thinner than the inner woody coat, middle spongy coat thicker than either. Length of seeds, 1 to 1.2 mm. ; breadth parallel with valve, 0.55 to 0.75 mm. ; dorsiventral thickness, 0.5 to 0.8 mm.

HOLOTYPE. V.43873.

DESCRIPTION. *Seed* : Inverted triangular pyramidal in shape with sharply angled edges, apex broad, sometimes but not invariably sloping away from the valve and meeting the sides at a sharp angle. Base often slightly stipitate. Dorsal side sharply angled the angle forming a conspicuous ridge associated with the raphe. Outlines of lateral margins concave or straight. Ventral side with a narrow triangular or obovate germination valve with its surface somewhat concave both in a longitudinal and transverse direction, confluent with the testa of the seed at its broad upper end and never separating from it in this region. It extends to the base of the seed below and gives rise to the stipitation. Outer surface of valve ornamented by about twelve narrow longitudinal grooves each with a line of pits (not clear in the figures). Micropyle sub-basal or basal between the pointed end of the valve and base of seed body. Hilum basal leading into dorsal raphe canal. Chalaza a large apical black circular scar about 0.11 mm. in diameter inside the seed cavity. Outer epidermal layer of testa abraded. Main thickness of testa showing three regions : an inner somewhat woody compact coat about 0.027 mm. thick near the apex, an outer similar but much thinner coat and a middle coat thicker than either of the other two (about 0.054 mm. thick where it could be measured) formed by a mass of spongy cells. Tegmen thin, longitudinally striate. Length of seeds usually about 1 mm., rarely as much as 1.2 mm. ; dorsiventral thickness of several seeds 0.5, 0.66, 0.75, 0.8 and 1 mm. respectively. Breadth, from side to side (i.e. parallel with the valve) 0.55, 0.7, 0.75 and 0.66 mm. in four seeds.

REMARKS. Sixteen seeds from the beds between Brambles and Linstone Chines. V.43880 (not figured) includes nine seeds. This species is very small in comparison with the living *Decodon verticillatus* or the fossils *D. globosus* E. M. Reid and

D. gibbosus E. M. Reid. The seeds are also much more sharply angled, a feature seen in mature seeds with well developed seed cavities as well as in immature specimens. In the dorsiventral depth they are most comparable with *D. gibbosus* but they do not resemble it closely in other respects. In the greater thickness of the internal woody layer they approach *D. verticillatus*. The differences indicated although slight appear to justify specific designation and the name *Decodon vectensis* has been given.

Genus **MICRODIPTERA** Chandler, 1957 : 107

? *Microdiptera parva* Chandler

(Pl. 31, figs. 99-107)

1957 *Microdiptera parva* Chandler, p. 107, pl. 15, figs. 133-149; text-fig. 2.

1961b *Microdiptera parva* Chandler : Chandler, p. 141, pl. 29, figs. 116, 117.

Microdiptera parva Chandler : Chandler (in press), p. 119, pl. 19, figs. 30-35.

DESCRIPTION. *Seed* : Usually much compressed dorsiventrally, subtriangular, oval, quadrangular, pentagonal or irregular in outline, differentiated into a median elongate-ellipsoidal body flanked by thin lateral wings, more or less convex on the dorsal surface. Raphe prominent, linear, longitudinal, median on the ventral face of the broad elongate seed-body, indicated by longitudinally striate cells. It is flanked by two deep concavities which are partly overlapped by a flap of wing. Hilum marginal. Germination by an elongate oval operculum or plug extending from the base of the dorsal face to about half to four-fifths of the length of the seed from the apex. Germination starts at the lower end of this plug where the micropyle is situated but the whole plug eventually separates completely from the seed along a finished suture. Surface of plug convex, sometimes markedly so in seeds where a pyrites cast of the seed cavity is preserved. Testa shining superficially due to a layer of angular cells of variable outline. Cells over the operculum arranged in about five to eight longitudinal rows which are 0.05 mm. broad. These cells are equiaxial or broader than long. Lining of seed of equiaxial regular small cells, best seen as impressions on the pyrites seed-cast. Similar cells are seen immediately underlying the equiaxial coarse cells of the operculum. Dimensions of seeds : 1) Length, 1.1 mm. ; breadth, 1.2 mm. 2) Length, 1.1 mm. ; breadth, 1.6 mm. 3) Length, 1.25 mm. ; breadth, 1.1 mm. 4) Length, 1 mm. ; breadth, 1.25 mm. 5) Length, 1 mm. ; breadth, 1.1 mm. 6) Length, 0.9 mm. ; breadth, 1.75 mm.

REMARKS. The relationship to Lythraceae has been discussed earlier (Chandler, 1957 : 108). The species resembles *Microdiptera parva* closely and is appreciably smaller than *M. major* (Chandler, in press). In some degree the Upper Headon specimens are abnormal. The majority have all cavities filled with pyrites which has distended them and ruptured the thin carbonaceous walls. Later these walls have flaked away wholly or in part leaving conspicuously convex casts of the opercula or seed-bodies which form therefore unusually striking features. A few unpyritized seeds were found which do not show these distinct convexities, thus indicating that they are due to preservation and are not of specific significance. The seeds are therefore referred provisionally to *Microdiptera parva* although attention is called to the unusually long plug in some specimens which may extend to the apex of the seed.

There are also the following abnormal features. The seed in Pl. 31, figs. 105, 106 has a particularly well preserved surface. It shows longitudinal striae on both sides of the body ventrally and irregular striae mostly diverging from the body over most of the wing surface. In this specimen the plug extends almost to the top of the seed and it is swollen and fusiform. On the ventral surface there is a deep narrow longitudinal groove on each side of the body which is broad and somewhat fusiform. In addition to figured specimens there is V.43885. All are from beds between Brambles and Linstone Chines.

One seed, now decayed, was peculiarly thick from back to front with large swollen body and small much reflexed wings causing the dorsal surface to be conspicuously convex. Its operculum extended almost the whole length of the dorsal surface. The seed-body on the ventral surface appeared broad and inflated, broadening upwards and extending throughout the length of the seed.

Family CAPRIFOLIACEAE

Genus *SAMBUCUS* (Tourn.) L.

Sambucus colwellensis n.sp.

(Pl. 31, figs. 108-113)

DIAGNOSIS. Seeds normally 1.5 to 1.75 mm. long rarely smaller. Furrows between sinuous transverse ridges deeper in this species than in *Sambucus parvula* from Hordle.

HOLOTYPE. V.43886.

DESCRIPTION. *Seed*: Obovate or elongate-obovate in outline, compressed, frequently concavo-convex at least in fossilization, anatropous. Micropyle and hilum terminal on the ventral face marked by a tiny slit-like aperture at the pointed end, raphe median longitudinal marked sometimes by a slight angle. Surface ornamented with about ten or more sinuous transverse sometimes interrupted ridges with deep furrows between them. Concave ventral surface with a distinct marginal rim. Testa formed externally of small equiaxial cells about 0.016 mm. in diameter and internally of larger ones. Germination by marginal splitting into two valves. Length of seed normally about 1.5 to 1.75 mm.; breadth commonly 0.75 to 1 mm. The smallest seed measured was 1.2 mm. long, 0.85 mm. broad. The broadest seed measured was 1.6 mm. long, 1.25 mm. broad. Several seeds 1.25 mm. long were seen which varied from 0.75 to 1 mm. in breadth.

REMARKS. Numerous seeds, somewhat similar to *Sambucus parvula* from the Lower Headon of Hordle in the surface ornamentation, but readily distinguished from that species by their considerably greater size. In *S. parvula* a length of 1.5 mm. is rare. The two species as they lie side by side can be distinguished at a glance by this character. The furrows between the transverse sinuous ridges also tend to be deeper in the Colwell than in the Hordle seeds. The Colwell seeds therefore appear to merit a distinct specific name, *Sambucus colwellensis*. As they are heavily pyritized shrinkage has no doubt been reduced to a minimum and the sizes quoted are in all probability the true sizes of the living seed. The specimens were also compared with

Sambucus mudensis from the Highcliff Sands, Cliff End, Mudeford (Chandler, in press), but that species has seeds as much larger than *S. colwellensis* as those of *S. colwellensis* are than seeds of *S. parvula*. *Sambucus* seeds are among the commonest of the Upper Headon plant remains and can be found all along the section suggesting a line of elder trees or elder scrub overhanging the river or marsh. The figured specimens were collected below the sewer at Linstone Chine and between Brambles and Linstone Chines. In addition there is V.43892 from the last locality and V.43893 from folded beds close to Fort Victoria boundary fence.

Family EPACRIDACEAE

Genus *EPACRIDICARPUM* Chandler, 1960 : 214

Epacridicarpum headonense Chandler

(Pl. 31, figs. 114–116)

1960 *Epacridicarpum headonense* Chandler, p. 234, pl. 34, figs. 146, 147.

1961b *Epacridicarpum headonense* Chandler : Chandler, p. 146, pl. 29, figs. 134–137.

Epacridicarpum headonense Chandler : Chandler (in press), p. 126, pl. 21, figs. 2–5 ; text-fig. 23.

DESCRIPTION. *Fruit* : A subhemispherical or oblate-sphaeroidal five-loculed loculicidal capsule. Upper surface somewhat flattened, lower convex (stipitation not preserved), axis stout, fibrous, flat-topped. Surface with irregular pits. Walls thick ; inner layers of elongate longitudinally aligned cells which diverge from the subapical axile placentae. Dimensions of several fruits : 1) Diameter, 1.6 mm. ; dorsiventral thickness, 0.8 mm. 2) Diameter, 1.3 mm. ; dorsiventral thickness, 1 mm. 3) Diameter, 1.75 mm. ; dorsiventral thickness, 1.25 mm.

REMARK. The specimen has now split loculicidally into its component valves. When first seen and photographed (Pl. 31, fig. 114) these hung together but had contracted near the axis making oval apertures prolonged as splits along the lines of the locules. The decay of the axis has in some specimens left a gap at the apex and an empty canal below is now filled with sand. In addition to the figured material there is V.43987, all from between Brambles and Linstone Chines. The specimens are identical with the Hordle species which is known also from the Lower Bartonian of Barton and the Highcliff Sands of Mudeford.

Epacridicarpum colwellense n.sp.

(Pl. 31, figs. 117–119)

DIAGNOSIS. Fruit five-carpelled, subsphaeroidal but somewhat depressed dorsiventrally. External surface finely and evenly pitted, the upstanding walls of the pits producing rugosities. Sharply angled over the locules with deep concavities over the septa. Transverse diameter about 1.25 to 1.5 mm. Dorsiventral diameter, 0.75 to 1 mm.

HOLOTYPE. V.43898.

DESCRIPTION. *Fruit* : Syncarpous, five-carpelled, subsphaeroidal but somewhat depressed so that it is broader than long, having five longitudinal angles so that the

outline as seen from above or below is somewhat star-shaped with deep concavities between the angles. The angles overlie the locules. Dehiscence loculicidal. Axis thick and fibrous. Locules with elongate cells diverging from the inner apical angle. External surface somewhat rough, finely and more or less evenly pitted, the raised walls of the pits producing the rugosities. Placentation probably axile at the apical angle of the locules from which the cells diverge. No seeds seen. Dimensions: 1) Maximum transverse diameter, 1.5 mm.; dorsiventral thickness (crushed and therefore reduced), 0.75 mm. 2) Transverse diameter, 1.25 mm.; dorsiventral thickness (scarcely crushed), 0.75 mm. 3) Transverse diameter, 1.24 mm.; dorsiventral thickness, 1 mm.

REMARKS. The specimens are mostly obliquely distorted. They differ from *Epacridicarpum mudense* Chandler (1960: 214, 235, pl. 31, fig. 57; pl. 34, figs. 148-150), another somewhat angled species in the relatively smooth surface with fine pitting and the more marked angles over the locules with deep depressions over the septa. In addition to figured material there is V.43901 including several fruits. All are from beds between Brambles and Linstone Chines.

Family ?

Genus **RHAMNOSPERMUM** Chandler, 1925 : 30

Rhamnospermum bilobatum Chandler

1962 *Rhamnospermum bilobatum* Chandler : Chandler, p. 146, pl. 23, figs. 18-38; pl. 24, figs. 1-9. See also for earlier references.

The species is common. Specimens are frequently much crushed, distorted and shrivelled. Often only the inner semitranslucent coat is preserved. A unique specimen from the Upper Headon apparently attached to a stalk, possibly provided with a ring of calyx lobes, is described by Chandler (1962 : 146, pl. 24, figs. 8, 9). Typical measurements of Upper Headon material are length, 2.75 to 3.5 mm.; breadth, 3 mm.

INCERTAE SEDIS

Carpolithus colwellensis n.sp.

(Pl. 32, figs. 120-126)

DESCRIPTION. *Fruit* : Inferior, one-loculed, tapering towards the apex, the greatest breadth being at or just above the base, having three longitudinal facets, one broad and flat, occupying half of the circumference, the other two narrower meeting the broader facet to form marginal angles, and one another to form a median longitudinal angle on the opposite side of the fruit to the broad facet. Along all three longitudinal angles a furrow can be seen down which splitting may occur starting at the apex. Apex with three small short or broad patent triangular perianth segments one opposite each facet. Externally the segments show longitudinal puckering at their tips. Base of fruit (usually broken) in the best preserved specimen somewhat excavated (Pl. 32, figs. 122, 123), a slight marginal ridge around the excavation delimiting an ellipsoidal or oval depression with a small median scar. Surface rough with inconspicuous tubercles arranged in longitudinal rows. The tubercles are slightly elongate

longitudinally and about 0.016 mm. broad. There are also superficial rectangular inflated cells producing a tubercled effect. Tubercles and cells together give a "rippled" surface. When abraded a finer surface is exposed with longitudinal lines of cells only about 0.008 mm. broad. In one specimen a valve has come away along two of the ridges showing the single locule and a columnar wall built of small rectangular cells radially aligned. Dimensions: 1) Length, 2.5 mm.; breadth, 1 mm.; thickness, 0.5 mm. 2) Length, 2 mm.; breadth, 0.75 mm. 3) Length (with incomplete apex), 2.25 mm.; breadth, 1.25 mm.; thickness, 0.5 mm. 4) Length, 2 mm.; breadth, 0.75 mm.; thickness, 0.5 mm.

REMARKS. The relationship of these much pyritized fruits has so far eluded discovery.

Carpolithus sp.

(Pl. 32, figs. 127-130; Text-fig. 2)

DESCRIPTION. Part of a capsule? Subcircular in outline, slightly narrowed to one end which bears a straight, obliquely directed pointed spine-like process arising at about 0.5 mm. from the margin as seen in profile (Text-fig. 2). The main part of the

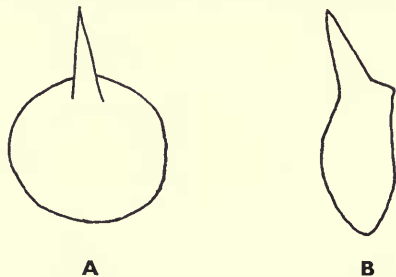


FIG. 2. *Carpolithus* sp. A, Inflated external surface of ? valve of capsule showing spine-like process. B, Same, side view.

specimen, when uncrushed, is inflated and almost hemispherical on the outer surface, deeply concave on the inner which has a finished suture-like flat edge. A collapsed specimen shows that the "spine" is hollow although there is no evidence of an aperture leading into it on the concave surface of the organ. Wall with two definite layers, an outer with coarse cells at right angles to the surface and an inner of equiaxial cells. Between the two layers the thickness appears to be of cells parallel with the inner margin but all are much obscured by sand-pitting. Length of body of uncrushed specimen, 3 mm. Length of body and spine, 4.75 mm.; breadth, 3.25 mm. Length of crushed specimen, 3.1 mm. including spine; breadth, 3.25 mm. In addition to figured material there are two imperfect specimens (V.43911) of which one shows the spine. The nature of these bodies is obscure but they may represent a valve of a capsule. All are from between Brambles and Linstone Chines.

Carpolithus spp.

(Pl. 32, figs. 131, 132)

Two ovoid seeds (now compressed in fossilization). In one (Pl. 32, fig. 132) the broader

end is very slightly flattened, the opposite narrowed but pointed. Surface shining, pitted, the pits about 0.013 mm. in diameter. Length, 1 mm. ; breadth, 0.7 mm. The second (Pl. 32, fig. 131) is similar in shape but not flattened at either end. Its surface is formed of small equiaxial polygonal cells. Length, 1.25 mm. ; breadth, reduced by folding, 0.75 mm. Both show little that is distinctive. They do not appear to be identical. Both are from beds between Brambles and Linstone Chines.

Carpolithus sp.

(Pl. 32, fig. 133)

DESCRIPTION. *Fruit* (or seed ?) : Elongate-oval in outline, narrowed to a point at one end (base ?), truncate at the opposite end where there is a subcircular or elliptical disc which may have borne a perianth or pappus. The specimen is somewhat compressed. The disc appears to be subdivided by a slight constriction at right angles to its maximum diameter giving it a slightly bilobed effect. At the opposite extremity of the fruit the cells converge suggesting an organ situated here. Surface rather rough formed of rounded cells about 0.008 mm. in diameter. Inner integument shining, semitranslucent, showing longitudinal rows of cells, the rows about 0.03 mm. broad, the cells transversely aligned producing transverse striation of the ridges where adjacent rows are contiguous. Length of specimen, 1.75 mm. ; breadth, 0.75 mm.

REMARKS. The single specimen (V.43914) is from beds between Brambles and Linstone Chines. The outer integument has flaked away showing the shining inner coat in patches. The specimen, with a disc at the apex, recalls *Typha* seeds but the cell structure is unlike that of *Typha* nor is its form as fusiform-truncate. It is appreciably larger than seeds of *Typha latissima* (length, 0.9 to 1.1 mm.). Its relationship has not been discovered.

Carpolithus sp.

(Pl. 33, figs. 140, 141)

DESCRIPTION. *Fruit* : Elongate-oval, somewhat truncate obliquely at one end, pointed at the other having a large scar (of attachment ?) at the truncation. More or less bisymmetric, somewhat compressed at right angles to the plane of symmetry in which it splits. External surface with a few inconspicuous broad longitudinal ridges, fine pits and small shining inflated cells. Locule lining having elongate longitudinally aligned cells with finely toothed walls 0.025 mm. broad. Length of fruit, 3.5 mm. ; breadth, 2 mm. V.43915, now much broken, from beds between Brambles and Linstone Chines. Relationship unknown.

Unknown leaf

(Pl. 32, figs. 134-139)

DESCRIPTION. Four small fragments of a long narrow leaf with pinnate rounded lobes on each side of a stout midrib. Fragments stiff, coriaceous, convex on the upper surface (Pl. 32, figs. 134, 136, 138). Margins of lobes sharply recurved onto the lower surface where they appear revolute and rounded making a pouch over the concave

lower surface of each lobe (Pl. 32, fig. 137). Midrib stout, prominent on the lower surface (Pl. 32, figs. 135, 137, 139), sunk in a narrow furrow on the upper surface (Pl. 32, figs. 134, 138). Other nerves indistinguishable but the pinnule or leaf lobes are separated from one another by deep curved furrows on the upper surface (Pl. 32, figs. 134, 136). Cells of upper surface straight-sided not digitate, angular equiaxial near the margin, somewhat elongate transversely to the length of the leaf near the midrib. Cells on lower surface longitudinally aligned and elongate over the midrib. One fragment representing the basal end narrowed downwards towards the stalk (Pl. 32, figs. 138, 139) was about 2 mm. long, 0.75 mm. broad and its lobes were only about 0.5 mm. long and had diminished at the lower end so as to have almost disappeared. V. 43916 represents the remains of this specimen. The largest fragment, now decayed, (Pl. 32, figs. 134, 135) was 3 mm. long, 1 mm. broad, the midrib on its lower surface being 0.25 mm. broad with pinnule lobes about 0.5 mm. long. A tiny fragment (Pl. 32, figs. 136, 137) must have been from a much larger leaf. Only three lobes were preserved on one side of the midrib and one on the other. The stout convex midrib measured almost 1 mm. in breadth on the lower surface and was flanked on each side by deep furrows representing the true lower surface exposed between the midrib and the revolute rounded upper margins of the pinnule lobes. In this larger specimen the lobes were from 1 to 1.2 mm. long. Only a fragment of one lobe (V.43917) remains. A fourth fragment (V.43918) is distorted and folded lengthwise and upwards upon itself along the rounded prominent midrib. It shows three rounded inflated lobes on one side and two on the other. Length of midrib, 2.5 mm. ; breadth of specimen as folded, 1 mm. Length of lobes, 0.75 mm.

REMARKS. The superficial appearance of this specimen resembles *Gleichenia*, but the straight-sided cells do not appear to support this relationship. It has not been possible to discover the affinities of these fragments found in a tiny film or pocket of vegetation in sandy beds between Brambles and Linstone Chines in which *Anemia colwellensis* was also discovered.

b) *The Osborne Beds*

Localities as stated under descriptions. Preserved in Museums stated.

PTERIDOPHYTA

Order FILICALES

Family POLYPODIACEAE

Genus *ACROSTICHUM* Linnaeus

Acrostichum lanzaeanum (Visiani)

(Pl. 33, fig. 142 ; Text-fig. 3)

1961b *Acrostichum lanzaeanum* (Visiani) : Chandler, p. 101, pl. 24, fig. 2. See also for earlier references.

Two small fragments of pinnule impression (No. 379 about 7 by 7 mm. ; No. 377 length, 17 mm. ; breadth, 15 mm.) have been found at Cliff End at the northern end of Colwell Bay. They were originally covered by carbonaceous substance but this

has now almost entirely chipped away exposing the underlying impression. The highly characteristic reticulate nervation is seen. The fragments are readily recognizable on account of the better preserved material so frequently found at older

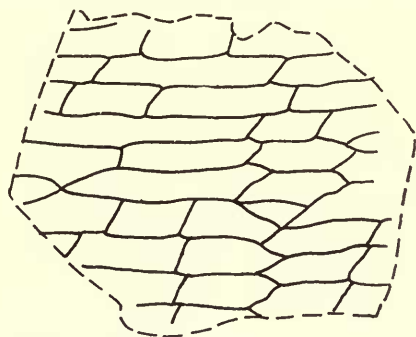


FIG. 3. *Acrostichum lanzaeanum* (Visiani). Fragment of leaf impression broken all round its edges.

Eocene horizons. Well preserved pinnules are also known from the Bembridge Beds. Both specimens were collected by Clement Reid and Henry Keeping and are preserved in the Geological Survey Museum. In the case of specimen 379 the edge of the specimen is broken and chipped away (Text-fig. 3). In 377 (Pl. 33, fig. 142) the fragment lay to one side of the midrib. The actual midrib and margin are missing.

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family HYDROCHARITACEAE

Genus **STRATIOTES** Linnaeus

? *Stratiotes neglectus* Chandler

(Pl. 33, figs. 143–146)

1923 *Stratiotes neglectus* Chandler, p. 126, pl. 5, figs. 4, 27, 28; pl. 6, fig. 24.

1926 *Stratiotes neglectus* Chandler: Reid & Chandler, p. 74, pl. 4, figs. 13, 14.

DESCRIPTION. *Seed*: Suboval or oblong, hooked at the base, much flattened; keel moderately broad but thin and sometimes broken causing the seed to appear sigmoidal (Pl. 33, figs. 144, 146), not continued round the base but merging into the collar which is relatively large and prominent, rounded and smooth or slightly rough; testa thin, woody with irregular longitudinal tubercles often coalescing to form longitudinal ridges rarely continued onto the collar, sharp and thin when well preserved. Surface pitting fairly coarse; micropyle basal oblique; hilum dorsal near the base; raphe marginal from the hilum upwards for at least half its length, thereafter diagonal entering the seed cavity at the apex. Width of the testa outside the diagonal portion less than that inside in the only specimens where it is exposed. Digitate cells of interior of keel (seen in one specimen only) tortuous near the base. Length of seeds about 2.9 to 3.5 mm.; breadth about 1.6 to 2 mm., much flattened.

REMARKS. The seeds from the Osborne Beds of Osborne are clearly immature or abortive, battered and much crushed, several have broken in part along the line of the raphe giving a spuriously sigmoidal outline. Their characters so far as they could be ascertained suggest *Stratiotes neglectus*, but in view of the condition of these specimens the determination is regarded as provisional. In addition to four figured seeds or valves there are twenty-one others (V.43927).

Class DICOTYLEDONES

Family NYMPHAEACEAE

Genus *NELUMBIUM* Juss.

Nelumbium buchii Ettingshausen

1862 *Nelumbium Buchii* Ettingshausen : Heer, p. 374, pl. 18, fig. 19.

1888 *Nelumbium Buchii* Ettingshausen : Gardner, pp. 417, 423, pl. 4.

A characteristic but poorly preserved fragment of a rhizome of the type attributed by Heer and by Gardner to *Nelumbium buchii* Ettingshausen (see p. 376) is in the Geological Survey Museum (No. 360 XX 6/16a) from Cliff End near Colwell Bay.

INCERTAE SEDIS

Genus *DICOTYLOPHYLLUM* Saporta emend. Bandulska, 1923 : 244

Dicotylophyllum pinnatifidum Reid & Chandler

(Pl. 33, fig. 147 ; Text-fig. 4)

1926 *Dicotylophyllum pinnatifidum* Reid & Chandler, p. 151, pl. 10, figs. 8-12.

DESCRIPTION. *Leaf* : Represented by a tiny carbonaceous fragment at the tip of a pinnatifid leaf with about six rounded segments. The sunk midrib is well shown. Secondary nerves, alternate or opposite, arise from it at a wide angle, one running towards the tip of each segment. Each nerve gives off a reflexed branch which passes towards the sinus below and, perhaps owing to curling of the leaf margin, appears to pass into the sinus. Margins of segments entire so far as seen but not sufficiently well preserved to show the hyaline border described in the Bembridge specimens. The fragment is only about 6 mm. long and its maximum breadth is 2.25 mm. From the Osborne Beds of Cliff End near Colwell Bay. No. 376 Geological Survey Museum.

There is no further light on the identity of the species but attention is called to a resemblance it bears to a compound leaf, or stem bearing several leaves, reproduced by Krystofovich (1957 : 391, text-fig. 383) after Korovin (1949) who had named it *Palibinia densifolia* and referred it to the Proteaceae. The figure shows a leaf of similar form and there is some suggestion of a hyaline margin, but the branching of the nerves is not clear and without comparison of actual material it is not possible to say whether the two are identical. *Palibinia densifolia* is also described and figured by Vachdevcka in 1957 (in Krystofovich, 1957 : 143, pl. 4, figs. 1-5 where references are given to papers in 1932, 1934).

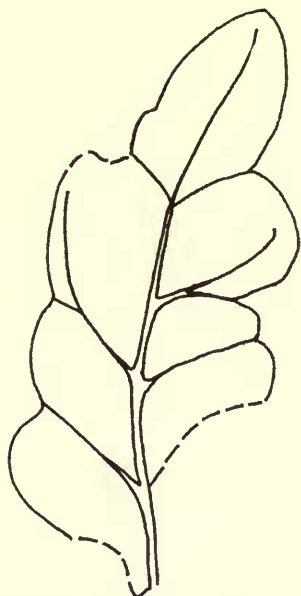


FIG. 4. *Dicotylophyllum pinnatifidum* Reid & Chandler. Diagram showing outline of leaf fragment and nerves.

(c) *Bembridge Beds*

Localities of new material as indicated in text.

PTERIDOPHYTA

Order FILICALES

Family SCHIZAEACEAE

Genus *ANEMIA* Swartz

Anemia sp. (? *A. colwellensis* Chandler)

1926 *Filix incertae sedis*, sp. 5 Reid & Chandler, p. 39, pl. 1, figs. 10, 11.

1955 *Anemia* sp.3 Chandler, p. 307, pl. 36, fig. 65.

1955 ?*Anemia colwellensis* Chandler, p. 304, pl. 35, figs. 39, 40, 42-53; pl. 36, figs. 59-64; text-fig. 2, 1.

In 1955 it was suggested that this Bembridge species might conceivably be barren material of *Anemia colwellensis*. There is a resemblance to the pinnule segments of this species both in the flabellate nervation and in the smoothness of the margins. Further experience of *Anemia* lends support to this view but as no conclusive evidence can be produced the barren pinules are merely referred doubtfully to the Colwell species.

GYMNOSPERMAE

Order CONIFERALES

Family ARAUCARINEAE

Genus *ARAUCARITES* Presl, 1838 : 203*Araucarites gurnardi* Florin1926 *Araucarites gurnardi* Florin in Reid & Chandler, p. 48, pl. 2, figs. 6-19.1926 *Doliostrobus* sp. (*Araucarites gurnardi* ?) Reid & Chandler, p. 52, pl. 2, figs. 17, 18.1961a *Araucarites gurnardi* Florin : Chandler, p. 27.*Araucarites gurnardi* Florin : Chandler (in press), p. 39, pl. 1, fig. 3 ; pl. 2, figs. 4, 5.

A few additional facts are available about the cuticle of *Araucarites gurnardi* some of which have been mentioned by Chandler (1961a : 27). In contrast to *A. selseyensis* the stomatal bands extend almost throughout the length of the leaf on the dorsal side. On the ventral side there are more stomata in an uninterrupted line (sometimes as many as ten) in *A. gurnardi* than in *A. sternbergi* Goeppert (= *A. goepperti* (Sternberg) of Gardner) from the Bournemouth Beds (described Chandler, in press, pl. 1, figs. 1, 2, 4-13 ; pl. 2, figs. 1-3, 6-10 ; pl. 7, fig. 12). On the whole the ordinary epidermal cells tend to be more parallel-sided and rectangular-ended while pits (or papillae) are a most conspicuous feature. As in other species a double ring of subsidiary cells is commonly present around the stomata. The outer stomatal pore may be 0.02 to 0.03 mm. long, exceptionally up to 0.046 mm. It is usually elliptical but sometimes subcircular. For additional figures of *A. gurnardi* cuticle and remarks see Chandler (in press, pl. 1, fig. 3 ; pl. 2, figs. 4, 5). There are also eleven slides (V.44306-16).

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family POTAMOGETONACEAE

Genus *POTAMOGETON* Linnaeus*? Potamogeton* sp.

(Pl. 33, figs. 148, 149)

DESCRIPTION. At least five layers of leaves preserved as impressions and arranged radially around a central axis or stem producing a superficial resemblance to a flower. In vertical thickness the specimen measures not more than 7 mm. The leaves are obovate, broadest at a little above the middle, flat, thin, probably sessile, with finely toothed margins (Pl. 34, fig. 149), the teeth being spaced at intervals of 1.25 to 1.5 mm. ; midrib prominent on the lower surface, broader and thicker than the subparallel lateral nerves (three or more pairs) which flank it on each side. The nerves converge both towards the base and apex and unite at the apex. The interspaces between these nerves are subdivided by thin, short, straight, longitudinal and transverse nerves into oblong spaces (0.15 by 0.1 mm. in diameter) accurately aligned in transverse rows. The oblong spaces are again subdivided by finer nervules into polygonal spaces, 0.6 by 0.3 mm. to 0.3 by 0.25 mm. in diameter ; these are filled by large hexagonal cells (0.05 mm. in diameter) which form the substance of

the lamina. Certain small confused impressions near the stem suggest the presence of short broad stipules, but the leaf bases are so close together that it is not possible to be sure of this. The epidermis is smooth and formed of small longitudinally aligned cells (0.025 by 0.016 mm. in diameter). Usually it is not preserved and the surface then shows impressions of the large hexagonal cells within.

REMARKS AND AFFINITIES. One specimen preserved in a waterworn nodule which when split along the bedding plane showed counterpart impressions. V.23428 shows the under surface of the leaves which evidently floated with blades expanded and have been embedded in this position. The internodes appear to have been very short, since the nodes lie accurately one above the other as indicated by the centres from which successive layers of leaves radiate. The leaves appear to have been arranged in whorls, but this may possibly be a secondary effect and they may actually have been alternate, separated only by short internodes and therefore appearing as a radiating series. V.23428*a*, which is figured, shows the upper surface. It is not easy in the fossil to distinguish between true nerves and the bast bundles which run the length of the leaves and provide supporting tissue in *Potamogeton*. Every character but one described above is found in the genus, the exception being the compacted arrangement of the leaves due apparently to the absence of petioles combined with the shortness of the internodes. The relationship is undoubtedly with Potamogetonaceae, and possibly with *Potamogeton* itself, fruits of which have been described from the Insect Limestone (Reid & Chandler, 1926 : 66, pl. 3, figs. 20–22). Two other kinds of leaves referred to *Potamogeton*, both distinct from those described above, occur at this horizon (Reid & Chandler, 1926 : 67, 68, pl. 3, figs. 23, 24 ; pl. 4, fig. 9). It must, however, be remembered, that fruits referable to two species of an extinct genus of Potamogetonaceae, *Limnocarpus*, were also described from the deposit. Fruits of *Limnocarpus* are intermediate between *Potamogeton* and *Ruppia* in characters. It is therefore possible that the leaves under discussion belong to *Limnocarpus*, so the generic determination must be regarded as doubtful. From the Insect Limestone, Thorness Bay.

Genus **LIMNOCARPUS** Reid emend. Reid & Chandler, 1926 : 68

Limnocarpus forbesi (Heer)

(Pl. 33, figs. 150–153)

See p. 338.

V.43930–32 (figured) and V.43933 (numerous unfigured endocarps) were collected by C. Reid in the Bembridge Marls “below Chapel Corner, Wootton”, a new locality for the species.

Family HYDROCHARITACEAE

Genus **STRATIOTES** Linnaeus

Stratiotes neglectus Chandler

(Pl. 34, figs. 154, 155)

See p. 359.

Reid & Strahan (1889 : 198) in describing the Bembridge Beds state that in the

Brickyard at Werror "the junction of the Hamstead and Bembridge Beds is apparently shown. Above a black seam were found *Melania turritissima*, *M. Forbesii*, *Melanopsis*, *Paludina lenta*, Fish bones, and *Folliculites thalictroides* [*Stratiotes neglectus* ?] with other seeds, but the strata are so weathered that it is not easy to obtain details of the section, and it is possible that this black seam may be somewhat higher than the Black Band" (the base of the Hamstead Series). See also p. 372. If the seeds labelled Werror are indeed from the Hamstead Beds then the range of *Stratiotes neglectus* is extended higher than was previously recorded.

Additional material: V.40079 holotype, figured Chandler, 1923, pl. 5, fig. 27 and Pl. 34, figs. 154, 155. V.40080 figured Chandler, 1923, pl. 5, fig. 4. V.43934 figured Chandler, 1923, pl. 5, fig. 28. V.16540, V.43935-37 seeds. All the above from the Bembridge Marls, Hamstead Ledge. V.40082 and V.43938 include numerous seeds from the Bembridge Marls, Thorness Bay. There are also seeds in various stages of decay from Brick pits or Bore-holes in Bembridge (or possibly Hamstead ?) Beds collected by J. Rhodes and found in J. Groves' Collections as follows: J.R.4358-59 seed Ashlake. J.R.3511 (49. 12ft.) seeds, J.R.4481 Bore-hole 201 13ft. J.R.4370 Rhodes No. 7A from Werror and J.R.4367 No. 7 from carbonaceous clay Werror (V.43939).

Family ARACEAE

Section MONASTEROIDEAE Engler

Genus *RAPHIDOPHORA* Hassk (or *EPIPREMNUM* Schott)

Epipremnum ? (or *Raphidophora* (?)) *ornata* Reid & Chandler

- 1926 *Epipremnum ornatum* Reid & Chandler, p. 83, pl. 4, figs. 24, 25.
- 1958 *Epipremnum ornatum* Reid & Chandler: Dorofeev, p. 173.
- 1958a *Epipremnum ornatum* Reid & Chandler: Dorofeev, p. 543.
- 1959 *Epipremnum ornatum* Reid & Chandler: Dorofeev, p. 1104.
- 1960 *Epipremnum ornatum* Reid & Chandler: Kolesnikova, p. 118, pl. 7, fig. 2.
- 1961 *Epipremnum ornatum* Reid & Chandler: Kolesnikova, pp. 126, 128, pl. 10, fig. 4.

This Bembridge species is also recorded from a number of deposits in the U.S.S.R., viz. Oligocene of Rezhenka (Dorofeev, 1958: 173), of Byeloyarna on the River Tavda (Dorofeev, 1958a: 543) and of Koziulino on the River Tom (Dorofeev, 1959: 1104) all in Western Siberia. It also occurs in Miocene localities (Kolesnikova, 1960: 118, pl. 7, fig. 2; 1961: 126, 128, pl. 10, fig. 4). The uniform spongy equiaxial cells throughout the testa in the species are not fully in accord with the structure of *Epipremnum* as shown by Kirchheimer (1957, pl. 12, fig. 54a) and it seems probable that these seeds should be referred to the related genus *Raphidophora* (Dorofeev ex. lit. 9.5.59). The reference to *Raphidophora* is provisional only pending detailed study of living material. The genus occurs in the East Indies, tropical and sub-tropical Himalayas, the mountains of Malaya and is common in China. *Epipremnum* has a similar range but penetrates further south to Australia, Tasmania and New Zealand.

Family ZINGIBERACEAE

Genus *SPIREMATOSPERMUM* Chandler, 1925 : 17

? *Spirematospermum wetzleri* (Heer)

(or *S. headonense* Chandler)

1925 *Spirematospermum wetzleri* (Heer) Chandler, p. 17, pl. 1, fig. 8a-c ; text-fig. 5.

1926 *Spirematospermum wetzleri* (Heer) : Reid & Chandler, p. 84, pl. 5, figs. 6, 7.

1961b ? *Spirematospermum headonense* Chandler, p. 108, pl. 24, figs. 28-30 ; pl. 25, figs. 31, 32.

In rediscussing material of *Spirematospermum* from the Lower Headon of Hordle now referred to a distinct species from *S. wetzleri* (Chandler, 1961b : 108) the writer pointed out that the small size of the isolated seeds obtained from the Bembridge Beds suggests that they should possibly be redesignated *S. headonense*. Evidence is, however, insufficient for certainty on this point. A tiny but characteristic spirally striate fragment of seed (J.R.3511 49. 12ft.) was found in the Ashlake Brickpit by J. Rhodes where the upper part of the Bembridge Marls is seen (Reid & Strahan, 1889 : 175) and it probably came from this horizon as it was associated with *S. neglectus*. However, it must be borne in mind that the Black Band and lowest beds of the Hamstead Series were also exposed in this pit and the collector Rhodes made no definite statement about the horizon.

Class DICOTYLEDONES

Family ULMACEAE

Genus *CELTIS* Tourn.

Celtis edwardsi n.sp.

(Pl. 34, figs. 156-160)

DIAGNOSIS. Endocarp ovoid, reticulations of surface rather coarse and shallow as compared with many living species. Length about 3.5 mm. ; breadth in plane of symmetry, 3.5 mm. ; breadth at right angles to plane of symmetry, 3 mm.

HOLOTYPE. V.43919.

DESCRIPTION. *Endocarp*: One-loculed, one-seeded, ovoid but bisymmetric, pointed at the apex when perfect, with thick longitudinal ribs from which others diverge so as to form a coarse network in the meshes of which are shallow concave alveolae ; at the base (Pl. 34, fig. 159) four of the ribs, approximately at right angles to one another, are more conspicuous than the rest, two opposite ribs being continued to the apex where they become very prominent ; these lie in and emphasize the plane of symmetry. The other two may merge into the general network but may reach the apex. The apical prominence is pierced by a small median funicular canal leading to the apical placenta ; on each side of the prominence is a small median external depression delimited by a curved rib of the network (Pl. 34, figs. 156, 158). Surface cells irregularly polygonal 0.025 to 0.05 mm. in diameter. On the internal cast (=seed) is an apical rib corresponding in position with the external prominence, it is the cast of a depression in the locule in which the radicle lay. Average length of

endocarp, 3.5 mm. ; breadth in plane of symmetry, 3.5 mm. ; breadth at right angles to plane of symmetry, 3 mm.

REMARKS AND AFFINITIES. Nineteen specimens. Some are endocarps (V.43919, V.43921-22) others external or internal calcite casts. They are preserved in white limestone labelled F. E. Edwards Collection, Headon Hill. Similar material from the F. E. Edwards Collection in the Sedgwick Museum, Cambridge, has the additional information that they were from the Bembridge Limestone, Headon Hill. In the British Museum (Natural History) collection no horizon is mentioned.

Form and structure indicate *Celtis*. In size and in the somewhat ill-defined ridges bounding the alveolae the closest resemblance is to *Celtis sinensis* (China) and *C. rubronervia* var. *integrifolia* (Phillipines), but the fossils are somewhat smaller than the former and larger than the latter species. They are also more ovoid, the above mentioned living fruits being subglobular. The fossil endocarps are much smaller than either *C. australis* or *C. occidentalis* and the net veining is relatively much coarser than in these species. The fossil records of *Celtis* endocarps are too numerous to quote. The genus is especially abundant in American deposits. The Isle of Wight species is exceptionally small. It has been named after the finder F. E. Edwards who collected the material in 1867.

Family NYMPHAEACEAE

Genus **BRASENIA** Schreber

Brasenia ovula (Brongniart)

See p. 346

The seeds are too familiar and common to need further description as regards their general characters, but the preservation of the Bembridge specimens from Ashlake now makes it possible to add a few details about the cell structure. The surface cells of the embryotega are large and oblong. The hard testa, columnar in section, 0.075 to 0.1 mm. thick, is formed of interlocking deeply digitate cells in which the digitations reach almost to the centre of the cells, they are few in number from about three to six, commonly three divisions being seen at the centre which branch or broaden towards their extremities. The diameter of the cells measured from the ends of the digitations is from 0.05 to 0.075 mm. The inner surface of this columnar coat presents a honeycombed appearance, the cells on this surface measuring 0.025 to 0.05 mm. in diameter and having irregularly thickened margins. Within there is a second coat which may be 0.05 mm. thick. It is formed of small cells, 0.012 mm. in diameter; its outer surface is also honeycombed or pitted, the pits measuring 0.025 to 0.05 mm. This coat although in the closest contiguity with the testa is usually free from it in the fossils. It is sufficiently hard and resistant to preserve its form when the columnar coat has been removed. No doubt the honeycomb cells of the contiguous surfaces of the outer and inner coats are the outer and inner ends of the same layer of cells through which splitting has occurred in fossilization. The aperture of the embryotega pierces both coats. The tegmen which is tough and hyaline is formed of equiaxial cells (about 0.05 mm. in diameter) except around the embryotega where they are broader than long and arranged in concentric rows. Living

Brasenia seeds are always smaller than the largest fully developed fossils and their digitate cells appear larger and simpler with thicker digitations. However, there is a similar succession of coats, namely an outer columnar coat (0.2 mm. thick) with digitate cells (0.1 mm. in diameter) fused with an inner coat, somewhat spongy in texture (0.05 mm. thick) formed of small cells (0.01 to 0.0125 mm. in diameter). The tegmen is of equiaxial cells 0.0725 mm. in diameter.

Further material is from Ashlake Brickpit, Wootton Bridge, J. Rhodes Collection 4356 and 4357, also 4359 (labelled "5A Ashlake") and seed-casts labelled "46 9.6" to 11ft." There are seeds from Werror (? Bembridge Marls) J. Rhodes labelled "J.R. 4371 No. 7A Werror" and a few poorly preserved seeds from a Borehole "J. Rhodes 4436. BH 115. 14 to 15½ ft." V.32241 from the Upper Bembridge Marls, Whitecliff Bay, below Old School House.

Family RANUNCULACEAE

Genus *RANUNCULUS* Linnaeus

Ranunculus ovaliformis (Reid & Chandler)

(Pl. 34, fig. 161)

1926 *Samaravectis ovalis* Reid & Chandler, p. 142, pl. 9, figs. 14-16.

EMENDED DIAGNOSIS. Achene flattened obovate with broad, triangular, tapering style usually with reflexed tip. Seed-body small, central, achene bearing a few scattered tubercles which overlie it. Attachment giving rise to a narrow truncation. Margin of achene beyond limits of seed wing-like with radial striae.

ADDITIONAL MATERIAL. V.23429.

DESCRIPTION. *Achene*: One-seeded, subobovate, much flattened laterally, prolonged asymmetrically at the apex into a broad triangular tapering flattened style usually recurved at the tip which is finely pointed. The attachment slightly truncates the narrow end (Pl. 34, fig. 161). Seed only about one-third of the length and breadth of the achene, flattened obovate, represented by an internal cast in V.17628 (cf. Reid & Chandler, 1926, pl. 9, fig. 16 shown inverted). Surface of achene slightly inflated over the seed but flattened beyond so as to give the appearance of a wing-like flange beyond the locule. Funicle passing into fruit at the base where it forms a conspicuous ridge (channel on impression). Entry into seed not clearly seen but apparently at one side of its long lateral margin making the seed half anatropous. Surface of style longitudinally striate. Surface of fruit radially striate, the striae diverging from the margin of the seed, formed of elongate cells with sinuous outlines. On the central area which overlies the seed there are a few scattered small tubercles or processes (seen as pits on the impression). Surface of seed finely pitted. Length of V.23429, 6 mm.; breadth, 4 mm. Length of specimens previously described, 6 mm.; breadth, 3.5 mm. Length of seed-cast, 2.5 mm.; breadth, 1.5 mm.

REMARKS AND AFFINITIES. These impressions were not fully understood in 1926 and were therefore wrongly interpreted. They were then described and figured upside down. The difficulty of interpretation was enhanced by the poor preservation of the style (described as a stalk) in the holotype (V.17626) and in the figured speci-

men on V.17627. The style was also poorly preserved in V.18112, both it and the holotype lacking the flange-like margin which passes into the flanged region of the achene. Again in V.18111 the style appears to be obscured or broken. The discovery by G. W. Colenutt of a finely preserved specimen at Thorness Bay made the true affinities of the species clear. The majority of living species of *Ranunculus* differ in having a large seed surrounded by a narrow marginal longitudinally striate rib in place of a flange simulating a wing around a relatively small seed. *R. asiaticus* has a large flat recurved style, small seed-body and broad flange radially striate in the upper part of the achene much as in the fossil. Its size is similar but the seed-body is situated in the lower half of the fruit, not medianly, and the shortest margin between attachment and style is longitudinally striate. *R. nissianus* has a narrower flange around a relatively larger seed but has sparse tubercles scattered over the external surface overlying the seed as in the fossil. Such processes are larger and more conspicuous in *R. trilobus* and *R. parviflorus*. The species can now therefore be referred to *Ranunculus* as *R. ovaliformis*, the change of specific name being due to the pre-occupation of *ovalis* within the genus *Ranunculus*.

INCERTAE SEDIS

Genus **CARPOLITHUS** Linnaeus

Carpolithus sp.

(Pl. 34, figs. 162-165)

1926 *Carpolithus* sp.2, Reid & Chandler, p. 143, pl. 9, fig. 18.

1926a Unidentified endocarp, Reid & Chandler, p. 378.

DESCRIPTION. *Fruit*: Obovate to broadly obovate in outline, having a thin brown epicarp separated from a thick hard endocarp by a layer of matrix impregnated with carbonaceous material (mesocarp?). Length of fruit (imperfect), 11.8 mm.; breadth, 11 mm.

Endocarp: Bisymmetric, obovate in outline with small apical mucro, somewhat flattened near the margin in the lower third giving a flanged effect; dehiscing in the plane of symmetry into equal valves, smooth externally, woody, 0.7 mm. thick about the middle, close-textured formed of parenchymatous tissue; pierced at the base by a pair of canals which are continued as grooves inside the locule one on each side in the plane of symmetry. From the grooves and from the base coarse fibres arise branching and anastomosing to form a network over the surface of the locule. Seed not seen. Length of endocarp, 8 to 9.75 mm.; breadth, 7.75 to 8 mm. Thickness incomplete, less than breadth.

REMARKS. Three specimens, possibly four, have been seen. V.17630 shows remains of fruit surrounding endocarp and was figured in 1926 (see reference above). Two specimens were later found by Mr. J. F. Jackson in a marly pocket in the Bembridge Limestone, Sticlett Ledge, near Gurnard. These are preserved in the Sandown Museum, Isle of Wight. A preliminary note recording the discovery was published by J. F. Jackson with a note on the plants by Reid & Chandler (1926a: 378), but there was no description nor was the connexion with *Carpolithus* sp.2 then

recognized. One specimen represents a single valve and shows the outer surface and that of the locule. The second shows one valve virtually perfect with the upper part of the second valve still adherent, the lower part having been broken. The mode of dehiscence and smooth suture are clearly seen. Both are here illustrated for the first time.

(d) *The Hamstead Beds*

Horizons and localities as given in the text.

GYMNOSPERMAE

Order CONIFERALES

Family TAXODINEAE

Genus *SEQUOIA* Endlicher

Sequoia couttsiae Heer

See p. 336.

Material from the Hamstead Beds was listed and figured by Chandler (1962, pl. 1, fig. 23; pl. 3, figs. 11-13; pl. 4, figs. 1-4, 24-26, 28-32; text-fig. 2(1)). This material and V.42344-48 was obtained by G. W. Colenutt from blocks of cement-stone fallen from the cliff at Hamstead. Heer (1862) figured cones, twigs and seeds prior to the publication of his fuller account of better preserved material from Bovey Tracey, Devon, so that Hamstead is in fact the type locality for this species (Chandler, 1962: 21). Most of Heer's material came from the Lower Hamstead Marls from a bed 7ft. above the "Black Band" of Forbes. Heer identified with his own species "*Taxites parisiensis* Brongn." recorded by Forbes (1886: 47) from the "Hempstead Beds". There are also slides 41045a-d prepared by Bandulska showing fragments of cuticle from Gardner's figured material 41045 (1883, pl. 6, fig. 2) see also 41423, V.15121-23. *Sequoia* twigs from 7ft. above the Black Band and specimens figured by Heer (1862, pl. 18, fig. 2) and by Gardner (1883, pl. 6, fig. 3) are in the Geological Survey Museum.

ANGIOSPERMAE

Class MONOCOTYLEDONES

Family TYPHACEAE

Genus *TYPHA* Linnaeus

Typha latissima Al. Braun

(Pl. 34, figs. 166-170)

1851 *Typha latissima* Al. Braun in Stizenberger, p. 75.

1926 *Typha latissima* Al. Braun: Reid & Chandler, p. 60, pl. 3, figs. 4-11.

DESCRIPTION. *Seed*: Pendulous, anatropous, elongate-ovoid, truncate at the micropyle, pointed at the chalaza which is indicated by a darkening and thickening of the testa. Micropyle large, closed by a flat disc with a central mucro; raphe

lateral, filiform. Testa formed of an outer light brown layer with hexagonal, transversely elongate cells, the angled ends of which alternate so as to produce zig-zag longitudinal ridges, these cells are about 0.05 mm. in transverse diameter and about 0.016 to 0.025 mm. in longitudinal diameter. One specimen shows a network of equiaxial cells with raised walls about 0.016 to 0.025 mm. in diameter. There is an inner delicate hyaline layer (tegmen ?) formed of long slender cells tapering at both ends. Dimensions of seeds: 1) Length, 1.1 mm.; breadth, 0.5 mm. 2) Length, 1 mm.; breadth, 0.4 mm. 3) Length, 1 mm.; breadth, 0.45 mm. 4) Length, 0.8 mm.; breadth, 0.35 mm. 5) Length, 0.95 mm.; breadth, 0.45 mm.

REMARKS. Numerous seeds, identical with those from the Bembridge Beds. The relationship to living species is fully discussed by Reid & Chandler (1926: 60). In addition to the figured material there are eight seeds from the Waterlily Bed at Hamstead (V.43945) and five from the same horizon at Bouldnor (V.43946).

Family SPARGANIACEAE

Genus *SPARGANIUM* Linnaeus

? *Sparganium multiloculare* Reid & Chandler

(Pl. 34, fig. 171; Text-fig. 5)

1926 *Sparganium multiloculare* Reid & Chandler, p. 63, pl. 3, figs. 12-18.

See p. 340.

DESCRIPTION. *Endocarp*: Woody, truncate ovoid, four-loculed, conspicuously grooved and angled longitudinally, the grooves lying between the locules emphasized by abrasion so that the locule cavities are in part exposed (Text-fig. 5). Carpels distinct and obconical at the base, truncate and slightly concave at the apex which is pierced by the large stylar canals, one to each carpel. Locule cavity ovoid, lined by small transversely aligned cells. Length of endocarp, 2.5 mm.; breadth, 1.9 by 0.9 mm. Seed not seen.

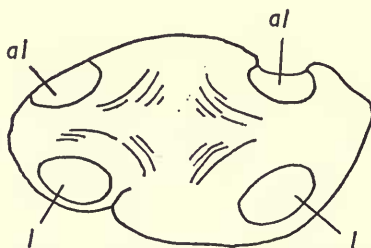


FIG. 5. ? *Sparganium multiloculare* Reid & Chandler. Diagrammatic drawing of the apex of endocarp showing apertures of four locules *l*, those marked *al* partly exposed on sides by abrasion.

REMARKS. One endocarp (V.43947) now collapsed. Although a small example, this endocarp agrees in other respects with *Sparganium multiloculare* from the Bembridge Beds, a species normally about 4 mm. long, to which therefore it is provisionally referred. From the White Band, Bouldnor.

***Sparganium* sp.**

(Pl. 34, fig. 172)

DESCRIPTION. *Endocarp*: Woody, originally obovoid? but base incomplete, contours smooth, not conspicuously furrowed longitudinally, narrower at one side than at the other giving a suboval transverse section. Apex truncate pierced by a large circular stylar aperture leading into a solitary locule. Wall very thick, maximum thickness about 1 mm., texture close and compact, structure somewhat obscure but near the exterior formed of parenchyma with cells about 0.014 to 0.018 mm. in diameter. Locule lining concealed by decay. Length of endocarp incomplete (broken transversely just below the level of its maximum diameter). Diameter, 2.75 by 2 mm. Diameter of stylar aperture, 0.7 mm.

REMARKS. The upper part of an endocarp, too imperfect for specific definition is undoubtedly a species of *Sparganium*. The solitary locule and smooth contours distinguish it from *S. multiloculare*. The single incomplete specimen (V.43948) is from the White Band, Bouldnor.

Family POTAMOGETONACEAE

Genus **POTAMOGETON** Linnaeus***Potamogeton tenuicarpus* C. & E. M. Reid**

(Pl. 34, figs. 173-176)

1910 *Potamogeton tenuicarpus* C. & E. M. Reid, p. 173, pl. 16, figs. 53, 54.1957 *Potamogeton tenuicarpus* C. & E. M. Reid: Chandler, p. 85, pl. 11, figs. 12-14.

DESCRIPTION. *Fruit*: Broadly obovate, originally somewhat inflated but now much flattened, curved through almost a complete circle about a subcircular or oboval central depression, the curved area forming the locule; dorsal margin semi-circular or gibbous, ventral margin slightly convex above and below, conspicuously indented between the ends of the limbs, i.e. between the convexities, at a distance of about a third of the length from the base of the fruit; sometimes there is a spine just above the indentation. Style small patent, terminal on the ventral margin. Surface having a conspicuous ridge around the central depression, around the dorsal margin adjoining the keel and along the middle of the keel, the ridges thin, forming sharp flanges. Keel broad reaching from the base almost to the apex, its median ridge flanked by a groove on each side. Surface cells about 0.012 by 0.02 mm. in diameter, somewhat irregular in shape aligned parallel with the curvature of the cavity, but also diverging from it. Length of endocarp, 1 to 1.5 mm.; breadth, 0.75 to 1.2 mm.

Seed: Narrow, elongate, curved like the locule; testa smooth shining, light brown, semitranslucent.

REMARKS AND AFFINITIES. Numerous specimens. In size, form and in every detail of structure there is exact agreement with *Potamogeton tenuicarpus* C. & E. M. Reid from the Bovey Tracey Lignite to which species it is therefore referred. The width of the keel indicates that in life the degree of inflation may have been considerable. For comparison with *P. pygmaeus* see Chandler (1957: 85). Szafer com-

pares endocarps from the Miocene of Gliwice, Poland, with *P. tenuicarpus* (1961: 84, pl. 23, figs. 19-21).

In addition to figured material from the Waterlily Bed of Hamstead (V.43949-50) and Bouldnor (V.43954-55) there are numerous unfigured endocarps from this horizon, V.43951 and V.43953 from Hamstead, V.43956 from Bouldnor and a few from the White Band, Hamstead (V.43952).

Genus **LIMNOCARPUS** C. Reid emend. Reid & Chandler, 1926 : 68

Limnocarpus forbesi (Heer)

(Pl. 33, fig. 153 ; Pl. 34, figs. 177, 178)

See p. 338.

REMARKS. It seems unnecessary to repeat a description of this now familiar species but three figures for comparison with material at other horizons are given. Reasons for reverting to Heer's specific name have already been stated (Chandler, 1961a : 28, 29). In view of this discussion Hamstead must be regarded as the type locality for *Limnocarpus forbesi* even although most of the material from this locality and horizon is crushed and flattened and preserved on flat surfaces in which the carbonaceous remains are embedded. An exception to this rule is seen in the specimen in Pl. 34, fig. 177 collected by Colenutt at Hamstead cliffs, a fully inflated carbonaceous endocarp washed out of the matrix and now decayed. In addition to figured material from the Waterlily Beds of Hamstead (V.43960) and Bouldnor (V.43957) there are the following unfigured numerous crushed specimens: V.43958 (from Bouldnor), V.43961-64 from Hamstead, all from the Waterlily Beds, and V.43959 from the White Band of Bouldnor. All the above Groves Collection. Also 41040, labelled *Cyperites forbesi*, in grey marl, much crushed and others from Middle Freshwater Marls. 41039, H. Keeping Collection.

The early collectors invariably collected this species on slabs thickly beset with crushed endocarps (cf. Geological Survey Museum specimens referred to by Chandler, 1961a : 28) like the original holotype. A block with endocarps in the Sedgwick Museum, Cambridge is from the Middle Freshwater Beds Hamstead and is labelled *Cyperites ? forbesi* by E. A. N. Arber.

Family HYDROCHARITACEAE

Genus **STRATIOTES** Linnaeus

Stratiotes neglectus Chandler

(Pl. 34, figs. 181, 182)

See p. 359.

Some peculiarly well preserved and characteristic seeds were found at Hamstead by A. G. Davis in association with *Potamaclis turritissima*. They were labelled Hamstead Beds. Prior to this *Stratiotes neglectus* had been found only in the underlying Bembridge Beds, with some doubtful immature seeds in the Osborne Beds (see pp. 359, 363). If the horizon is indeed Hamstead the range of *S. neglectus* is extended upwards, but it should be noted that although the species *Potamaclis* (*Melania*) *turritissima* is listed by Reid & Strahan (1889 : 292) from both the Bembridge and

Hamstead Series it is recorded abundantly from the Bembridge Marls only, with the possible exception of beds they described on p. 198. Hence the horizon may be doubtful in a section where Bembridge and Hamstead Beds are both exposed having regard to the fact that in the seam, gastropods and *Stratiotes* both abounded. There is no need to repeat the description of the species already given by Chandler in 1923 and Reid & Chandler in 1926. Typical seeds from the Bembridge Marls are shown in Pl. 34, figs. 154, 155. Figured specimens labelled Hamstead Beds are V.43968-69 and unfigured material V.43970.

Stratiotes websteri (Brongniart)

(Pl. 35, figs. 183-186)

1923 *Stratiotes websteri* (Brongniart): Chandler, p. 128, pl. 5, figs. 7-12, 31; pl. 6, figs. 1-5, 26. See also for earlier references.

1957 *Stratiotes websteri* (Brongniart): Chandler, p. 86, pl. 11, figs. 15-19.

REMARKS. The species has been fully described in the above references and there remain only a few minor alterations or additions: viz. the longitudinal ridges which ornament the surface are rounded and interrupted; occasionally traces of ridges or tubercles are seen on the collar; the pitting on body, collar and keel is more or less uniform, typical pits measuring about 0.05 mm. in diameter. Length of seed varies from 5.25 to 7.5 mm.; breadth from 2.25 to 3 mm. A small probably abortive seed measured only 3.1 mm. in length; 2 mm. in breadth.

The seeds are very abundant at certain horizons and include among normally developed specimens a few which are exceptionally small. They are no doubt undeveloped and abortive specimens such as occur in the many-seeded fruits of living *Stratiotes*. A few of the large seeds show a thin adherent layer of clay with filmy light brown tissue embedded within it. This tissue arises from the woody testa and may be an outer dried up mucilaginous coat not commonly preserved in fossilization. The presence of these filmy remains suggests that the rounding of the longitudinal ridges and the shortness of the transverse raphe canal in the hard testa are not due to abrasion but are original characters in this species.

Many seeds from Hamstead have been compared with seeds from Bovey Tracey and from the *Cyrena*-marls of Offenbach on Main. Specimens from the three localities are indistinguishable although the Offenbach seeds tend to be somewhat smaller and rougher with a slightly smaller collar.

No holotype has ever been designated so V.43971 (Pl. 35, fig. 183) has been chosen. It was collected in the White Band at Hamstead and is a very typical well developed seed. In addition to figured material which includes V.43976 (Chandler, 1923, pl. 5, figs. 7-9), V.40070 (Chandler, 1923, pl. 5, fig. 31) and V.42039 (Chandler, 1923, pl. 6, fig. 1) there are the following: numerous seeds from the White Band V.16543, V.40072-73, V.43972 Hamstead, and V.43973, V.43977 Bouldnor and two from the Waterlily Bed (V.43978 Bouldnor). 14235 includes impressions of seeds? *S. websteri* alleged to come from the Eocene of the Isle of Wight, presented by the Marchioness of Hastings, probably from the Hamstead Beds and V.40071, V.42040 from the Hamstead Beds

Allusions to *Stratiotes*, under the names *Carpolithes thalictroides*, *Carpolithes websteri* and *Folliculites thalictroides* are found in the Geological Survey Memoirs (Forbes, 1856 ; Bristow, 1862 ; Reid & Strahan, 1887) in accounts of the Hamstead Beds. As they are without figures or descriptions it is not possible to tell to which species (*S. websteri* or *S. acuticostatus*) the seeds in question really belonged. References to these names are given in detail in the synonymy by Chandler (1923).

Stratiotes acuticostatus Chandler

(Pl. 35, figs. 187-192)

1923 *Stratiotes acuticostatus* Chandler, p. 127, pl. 5, figs. 5, 6, 29, 30 ; pl. 6, fig. 25.

(Possible earlier allusions to the species (all doubtful) under the names *Folliculites thalictroides*, *F. websteri* or *Carpolithes websteri* are listed among the synonyms published by Chandler (1923). See note under *Stratiotes websteri* above.)

DIAGNOSIS. Seed oblong, oval or narrow-oval, often much flattened, very slightly hooked at the base ; keel usually broad, collar small, testa with conspicuous sharp serrated ridges, pitting coarse, pits up to 0.1 mm. in diameter, micropyle sub-basal, oblique ; hilum dorsal near the base, raphe marginal to the middle of the dorsal side, thence diagonal, diagonal portion normally less concave to the interior than in *S. neglectus* ; cells of the interior of the keel straight with their length parallel to the length of the keel. Length about 5.5 to 6.75 mm.

HOLOTYPE. V.40075.

REMARKS. The species was first described by Chandler in 1923. There is little to add to this account except that the surface pits of mature seeds are much coarser than those of *S. websteri* and *S. neglectus* and are commonly 0.1 mm. in diameter on the general surface and may be even larger on the keel. The length varies from about 5.5 to 6.75 mm. ; the breadth from 2.5 to 3 mm. Abortive small and ill developed specimens are however common (Pl. 35, figs. 190-192) and are sometimes segregated in separate pockets. A typical immature seed measures 4.25 mm. in length and 1.75 mm. in breadth.

In addition to the holotype (figured Pl. 35, fig. 187 and Chandler, 1923, pl. 5, fig. 5) and other figured material (V.44653 Pl. 35, fig. 189 and Chandler, 1923, pl. 5, fig. 6 ; V.40074 Pl. 35, fig. 188 and Chandler, 1923, pl. 5, fig. 30 ; V.44654 Chandler, 1923, pl. 5, fig. 29 now partly broken ; small seeds V.44174, V.44176, V.44179, Pl. 35, figs. 190-192) there are V.16541-42, V.44175, V.44180-83 comprising numerous seeds varying in degree of abrasion, all from Bouldnor Cliff and V.44184 from Hamstead. V.44177 are from the White Band, Bouldnor and V.44178 from the Waterlily Bed, Bouldnor. *Stratiotes websteri* and *S. acuticostatus* occur intermingled in the White Band, Hamstead Beds. 52613 is an indurated shaly slab of ironstone, not localized, but almost certainly Hamstead Beds. V.841 with an admixture of *Brasenia* : the *Stratiotes* sp indeterminable ? but may be a mixture of *S. websteri* and *S. acuticostatus*. V.44651 ? *S. acuticostatus* "Hempstead Beds". 52614 ? *S. acuticostatus* labelled Colwell Bay but is almost certainly from Hamstead.

Family CYPERACEAE

Section CARICOIDEAE

Genus **CARICOIDEA** Chandler, 1957 : 86? **Caricoidea minima** (Chandler)

(Pl. 34, figs. 179, 180)

1961b *Caricoidea minima* (Chandler) : Chandler, p. 105, pl. 24, figs. 18-21.

See p. 340.

DESCRIPTION. *Endocarp* : Oburceolate, broadest at about the middle, pointed above, truncate below where it is narrowed into a short neck with spreading margin, pierced by a basal aperture. Length of neck more than one-sixth the length of the whole endocarp, width in the narrowest part about half that of the endocarp. Some specimens show two longitudinal ridges from base to apex, in others they are seen only on the neck dying out above. Sometimes they are absent altogether (abrasion ?). A tendency for the neck to be bilobed is noted, the lobes being continued into that part of the endocarp between the ridges when these are present, the concavities between the lobes marking the termination of the ridges. Surface rough, cells equiaxial, about 0.012 mm. in diameter, arranged in longitudinal rows especially on the neck so as to give an obscurely striate appearance. Walls thick, formed of parenchyma. Length of endocarp, 1.25 to 1.5 mm. ; diameter, 0.9 to 1.2 mm.

Seed : Represented by thin testa formed of transversely elongate cells which produce transverse striations.

REMARKS. Thirteen specimens, all but one much compressed. They are referred to the form-genus *Caricoidea* and provisionally to the species *C. minima* (Chandler). It is doubtful whether the spreading split neck is itself a specific character which could separate the Hamstead material from this Lower Headon species in view of the fact that varying degrees of spreading may be observed among living specimens of *Cladium mariscus*. A greatly exaggerated degree of spreading is apparent in *Caricoidea* (? *Cladium*) *colwellensis* from the Upper Headon (p. 340). The fruit characters seen in material from the Lower Headon of Hordle appear to separate these fossils definitely from the living *Cladium* (Chandler, 1961b : 106).

In addition to two figured specimens there are extant V.43967 from the Waterlily Beds of Bouldnor cliff and V.44842 from Hamstead Beds, Hamstead cliff.

Family PALMAE

Genus **SABAL** Adanson***Sabal major*** (Unger)

(Pl. 35, fig. 193)

1847 *Flabellaria major* Unger, p. 42, pl. 14, fig. 2.1855 *Sabal major* (Unger) Heer, p. 88, pl. 35 ; pl. 36, figs. 1, 2.1862 *Sabal major* (Unger) : Heer, pp. 373, 376.

Several leaves were found by Pengelley 7ft. above the Black Band which was taken by Forbes as the base of the Hamstead Series. They were described, but not figured, by Heer. Two he referred undoubtedly to *Sabal major*, they showed the

end of a petiole and base of a leaf with long tapering rachis having a maximum breadth of 44 mm., with pinnules attached on both sides agreeing wholly in their insertion, form and nervation with *S. major*, so he stated. A third specimen was doubtfully determined. It represented the central part of a leaf with pinnules 10 to 12 mm. broad, each with a median ridge and with numerous longitudinal nerves between each pair of which were four finer nerves.

These specimens have not yet been traced but one of them may be in the Geological Survey Museum (XXI 2/3).

Another specimen was collected by Henry Keeping in 1888 from the Middle Hamstead of Hamstead (Pl. 35, fig. 193). It is still in the Sedgwick Museum, Cambridge. It shows the impression of the lower surface with long tapering rachis extending throughout the length of the fragment. The base of the blade is markedly asymmetric, there are about thirty pinnules but their distal ends are not preserved so it is not clear whether they are multifid or multiplicate away from the centre. There is no evidence about the stalk nor about the ligule. Remains only of the carbonaceous substance of the leaf can be seen, most of it having flaked away as the specimen dried taking with it the remains of the ligule. The length of the fragment along the rachis is 105 mm. and the breadth at right angles to this about the same.

It appears to be a species of *Sabal* and is comparable with the Bembridge specimens described by Gardner 76582 (1888 : 423, pl. 5, fig. 2) and Reid & Chandler V.17560 (1926 : 79, pl. 4, fig. 26) as *Sabal major*. V.42038 is an imperfect leaf showing the rachis.

DICOTYLEDONES

Family NYMPHAEACEAE

Genus *BRASENIA* Schreber

Brasenia ovula (Brongniart)

(Pl. 35, fig. 194)

See p. 346.

Seeds are as common in the Hamstead Beds as in the Lower and Upper Headon and Bembridge. All the typical characteristics of the species are shown. One seed (V.44185) is figured from Hamstead. In addition there are specimens from the White Band (V.44186) and Waterlily Bed (V.44188-89) Bouldnor; from the White Band (V.2881), Waterlily Bed (V.44190), "Middle Freshwater Marls" (41422) and unspecified horizons (49902 internal casts only, 41041-42, 41044, V.44191) at Hamstead (=Hempstead). Some of the older material is labelled "Nymphaea Doris". V.841 from Hamstead is associated with *Stratiotes*, possibly *S. acuticostatus*.

Genus *NELUMBIUM* Juss.

Nelumbium buchi Ettingshausen

See p. 360.

Rhizomes and leaves attributed by Heer to *Nelumbium* occur, the former in abundance, especially in the strata which succeed the basal "Black Band". They are found chiefly 7 ft. above this horizon. Usually the leaves are immature or represented

by imperfect fragments only, but one all but perfect leaf (52712) was figured by Gardner (1888, pl. 4). According to the old label it was collected by H. Keeping in the Middle Freshwater Marls. Its actual margin was preserved in many places and the leaf was described in the following terms: "peltate, nearly circular in outline, notched on the uppermost margin and with radiating venation, the vein proceeding to the base of the notch being stronger than the rest. The principal veins fork, but reunite near the margin, and the secondary venation is obscure. The articulation with the petiole is very visible at the centre of the leaf". At an earlier date, however, Heer (1862: 374) had stated that delicate veins united the principal veins, the areas between them being filled up with fine reticulations [as in living *Nelumbium*].

The rhizomes, Heer states, are from 10 to 14 mm. thick but at the nodes, which may be 3 ft. apart, as much as 23 or 24 mm. thick. From the nodes numerous roots arise which fall away leaving crowded circular scars. Heer did not doubt the relationship of these rhizomes to *Nelumbium*, but Gardner (1888: 417) pointed out that they appear to have been quite hollow, not fleshy and succulent as in *Nelumbium*. While accepting the leaves unhesitatingly as *Nelumbium*, he appears to have doubted the relationship of the rhizomes. Their hollow condition may however have been due to decay of pithy tissue in fossilization.

The rhizomes were associated with macerated fragments of sword-shaped leaves (*Sparganium*? *Typha*?); hence it is clear that more than one genus was represented in the bed. Possibly therefore more than two genera were present so that if Gardner's doubt was justified the rhizomes may have belonged to another plant.

Gardner (1888) in his description of plate 4 comments that the rhizomes were identified by Heer and by Saporta as those of *Nelumbium* but "hitherto no trace, either of the remarkable fruit, or of the seeds, has accompanied them".

The striking abundance of Nymphaeaceae seeds, now referred to *Brasenia ovula* has been commented upon by older workers as well as by collectors at the present day.

It is a peculiar phenomenon that abundant seeds of the family occur in certain beds of the Hamstead Series and rhizomes with leaves and abundant leaf fragments in another bed. It inevitably raises the question whether the supposed *Brasenia* seeds and *Nelumbium* leaves and rhizomes belong to the same plant and if they do should they really be referred to one of these genera or to some extinct genus. The answer to this query cannot at present be provided. Apart from Gardner's figured leaf there are the following rhizomes in the British Museum (Natural History): 41043, 41421, 41425, V.1844-46, V.44828-30 labelled Middle Freshwater Marls.

Family ROSACEAE

Genus *RUBUS* Linnaeus

Rubus sp.

A single small, curved, laterally compressed spine with elongate base and smooth finely longitudinally striate surface, the striae being formed by small oblong longitudinally aligned cells. Length of spine, 2 mm. Similar spines were found at Hordle and Bovey Tracey both of which localities yielded *Rubus* endocarps. The spine has been compared with those of *Rubus* and *Rosa*, it agrees in cell structure with *Rubus*.

Family LEGUMINOSAE

Genus ?

(Pl. 35, fig. 195)

DESCRIPTION. *Seed* : Subglobular originally (now compressed). Hilum not seen owing to the compression. Surface smooth, cells small equiaxial producing a fine granulation, testa columnar in section, the ends of the columns producing the surface cells, breadth of columns about 0.006 mm., thickness of testa varying from 0.05 to 0.1 mm. Diameter of compressed seed, 3.3 by 2.5 mm. Two other specimens (decayed) possibly referable to the same species measured 3.2 by 3 mm. and 2.7 by 2.6 mm. respectively.

REMARKS AND AFFINITIES. These seeds at first sight resemble *Brasenia*, but no embryotega could be seen nor any digitate cells. When fractured to show the testa in section, the radial columns appear to be much narrower and longer than in *Brasenia*. The difficulty of detecting a hilar scar along the flattened edge suggests that this organ was very small, probably situated at the split in the margin. The relationship seems to be with Leguminosae, but there is insufficient evidence on which to base generic determination. V.44192 from the Hamstead Beds of Hamstead.

Family DROSERACEAE

Genus *ALDROVANDA* (Monti) L.*Aldrovanda intermedia* Reid & Chandler

(Pl. 35, fig. 196)

1926 *Aldrovanda intermedia* Reid & Chandler, p. 113, pl. 6, figs. 27-29.

DESCRIPTION. *Seed* : Oburceolate, with a narrow neck about one-seventh the length of the seed ; anatropous with longitudinal raphe ridge terminating in an apical mucro. Surface glistening, flatly tubercled, the tubercles about 0.025 mm. in diameter and less convex than those of *Aldrovanda ovata*. Inner coat not seen. Length of seed, 1.65 mm. ; diameter, 1.2 mm. ; length of neck, 0.2 mm.

REMARKS. One seed (V.44193) slightly broken at the neck. It agrees in size and shape and in the character of the tubercles with *Aldrovanda intermedia* Reid & Chandler from the Bembridge Beds. It is smaller than *A. ovata* from the Lower Headon of Hordle and Lower and Upper Headon of Colwell Bay.

Family AQUIFOLIACEAE

Genus *ILEX* (Tourn.) L.? *Ilex* sp.

(Pl. 35, fig. 197)

DESCRIPTION. *Endocarp* : Rounded-oblong in outline, inflated, rounded triangular in section, with a median ventral angle, the angle being formed by a thick fibro-vascular strand which gives off two alternating branches one on each side. The

vascular strand passes from a large oval basiventral scar of attachment to the apex of the ventral ridge where it makes a slight prominence. The carpel wall adjacent to this fibre strand is formed externally of coarse parenchyma beneath which the cells are aligned transversely. The dorsal surface is covered by a closely adherent layer of longitudinally striate fibres, the striations being parallel, not converging at the two ends, slightly oblique. It is not clear whether this layer forms part of the carpel wall or is accidentally adherent to it. Length of endocarp, 3 mm.; breadth, 1 mm. (increased by compression).

REMARKS. One endocarp (V.44194) from Hamstead represented by an internal cast in coarse-grained pyrites to which the carpel wall adheres on the ventral side. Size and form, position and character of attachment, the ventral vascular strand and its mode of branching, are identical with the characters seen in certain species of *Ilex* but there is nothing in the living carpels to correspond with the longitudinally striate dorsal layer described above. In *Ilex* all the inner horny layers are formed of transverse fibres with an admixture of oblique fibres. If, however, as suggested by the strict parallelism of these fibres with no hint of convergence to the attachment scar the longitudinal layer is not organically connected with the endocarp, but is only accidentally adherent to the specimen, then the structure indicates relationship with *Ilex*.

Family ?

Genus **RHAMNOSPERMUM** Chandler, 1925 : 30

Rhamnospermum bilobatum Chandler

See p. 355.

Additional material has been found in the Hamstead Beds where some seams are crowded with this plant which is often associated with *Stratiotes acuticostatus*. V.40937 (figured Chandler, 1962, pl. 24, fig. 5) from Hamstead. V.40938 (figured Chandler, 1962, pl. 24, fig. 6), V.44195-96 from Bouldnor cliff. V.44197-99 from the Waterlily Beds, Bouldnor.

INCERTAE SEDIS

Genus **CARPOLITHUS** Linnaeus

Carpolithus sp. (? *Spirematospermum* sp.)

(Pl. 35, fig. 198)

DESCRIPTION. *Pod* : Lanceolate, curved, incomplete at one end (apex ?), tapering to the other where there is a rounded point which appears to have been abraded. Angled longitudinally (original ?) above and below with about four strong longitudinal ribs on the exposed surface, narrowly ellipsoid in transverse section. Number of locules almost certainly one. Surface formed of hexagonal cells arranged in regular longitudinal rows, cells about 0.038 to 0.057 mm. parallel with the length of the pod, 0.057 mm. at right angles to it. Wall about 0.5 mm. thick. Seeds not seen. Length preserved, 70 mm.; maximum breadth, 9 mm.; thickness, 3 mm.

REMARKS. The specimen lies with one surface embedded in matrix. It is not certain which end of the pod is broken but it seems probable that it is the apex which

is missing. The surface cells very closely resemble those of *Spirematospermum headonense* from the Lower Headon of Hordle (Chandler, 1961b: 108, pl. 24, figs. 28–30; pl. 25, figs. 31, 32). It is possible that this pod belongs to the genus *Spirematospermum* but the evidence to establish this relationship is missing. In any case a different species is indicated as the Hamstead pod is much longer and narrower. Its original length cannot be estimated as, if it belongs to *Spirematospermum*, the apex would probably have terminated in a wide perianth disc without any appreciable narrowing of the pod towards it. One carbonaceous specimen (41424) from the Lower Hempstead Marls, Hempstead.

***Carpolithus* sp.**

1888 *Gardenia?* *Wetzleri* Gardner, p. 417, pl. 3, figs. 11–15.

A fruit figured by Gardner and described as a rounded or subangular capsule with thick valves and two or more cells is ligneous, leathery and indehiscent. It had two rows of black and shining, angular, closely fitting seeds. Gardner records that on removing some of these a second layer of seeds was disclosed beneath a thin wall, hence his statement that the fruit was two-celled with four rows of seeds. Plate 3, fig. 11 (Gardner, 1888) shows the pod. Beside it but separate from it lies a thick stalk which does not appear to belong. Figs. 12–15 show the seeds natural size but there is no hint of the spiral striae seen in *Spirematospermum* (formerly *Gardenia*) *wetzleri* as represented on seeds from Bovey Tracey or the German lignite, on those of *Spirematospermum headonense* from the Lower Headon of Hordle or on detached seeds from the Bembridge Beds. As this characteristic feature is not mentioned either it does not seem probable that the pod (no longer extant) can have belonged to *Spirematospermum*. Indeed Gardner (1888: 418) states "I am more inclined to place it under the Iridaceae".

***Carpolithus* sp.**

(Pl. 35, fig. 199)

DESCRIPTION. *Seed*: Obovoid, now much compressed, truncated by a gaping aperture at the narrow end. Testa formed superficially of pits or concave cells with sinuous outlines 0.025 to 0.05 mm. in diameter. Length of seed, 2.4 mm.; breadth, 2.05 mm. One seed (V.44187) from the White Band, Hamstead. It has not been determined but may conceivably be a peculiarly preserved *Brasenia* in which case the aperture is that of the embryotega. As the form is not typical of a *Brasenia* seed the specimen has been referred to *Carpolithus* sp.

***Carpolithus* sp.**

(Pl. 35, fig. 200)

A small flattened ovate seed or carpel, slightly asymmetric, with rough coat; attachment or chalazal scar at the middle of the broad end. Length, 2.1 mm., breadth, 1.5 mm. The systematic position has not been discovered. V.44200 from Hamstead Beds of Hamstead cliff.

Carpolithus sp.

(Pl. 35, figs. 201-204)

Small ovoid semitranslucent integuments (flattened in fossilization) with a projecting short cylindrical black organ at one end, often splitting median longitudinally at the other end. Cell structure obscure, but two coats can be distinguished, an outer (structureless?) layer broadest near the chalaza, which forms a narrow marginal flange and an inner somewhat denser yellow coat. Dimensions of three typical specimens are as follows: 1) Length, 0.95 mm.; breadth, 0.52 mm. 2) Length, 1.1 mm.; breadth, 0.55 mm. 3) Length, 1.3 mm.; breadth, 0.6 mm.

These integuments suggest a tegmen with a large thick black chalaza. If this is a correct interpretation the testa must have decayed and vanished completely. It must, however, be borne in mind that the absence of any cell structure may indicate a chitinous substance. If so, they may perhaps represent egg cases, possibly of an insect, not a seed at all. At present their true relationship is quite obscure. They are abundant in the Hamstead Beds. In addition to figured material from the Waterlily Bed, Hamstead, there are V.44204 from the same horizon and locality and V.44205 from Bouldnor.

(e) *Horizon?*

Locality Headon Hill.

Family ICACINACEAE

Genus *STIZOCARYA* Reid & Chandler, 1933 : 336*Stizocarya* sp.

(Pl. 35, figs. 205, 206)

DESCRIPTION. *Endocarp*: Globular with a slight bisymmetry about a plane in which the funicle lies. Dehiscence into equal valves along this plane. External surface much abraded, smooth (secondarily?) with numerous inconspicuous small pits marking the outer ends of cylindrical canals. These traverse the thickness of the wall at right angles to its surface and form similar but more conspicuous pits on the interior about 0.3 to 0.4 mm. apart. Canals occupied by compact oblong cells or fibres which form hair bases. Wall woody, 0.75 to 0.1 mm. thick, compact, formed of small parenchymatous cells, 0.016 mm. in diameter. Funicle only preserved near the apex where it traverses the wall diagonally to the apical placenta (Pl. 35, fig. 206). Length of endocarp, 15 mm.; breadth, 14 mm.

REMARKS. Two endocarps, both broken so that the internal characters are displayed. They were in a box containing two differently preserved specimens obviously from other horizons. On the box lid was "F. E. Edwards Coll." and the late W. N. Edwards stated that it was in a batch of material which was sent to the British Museum (Natural History) as "Searles V. Wood Collection". Inside the box was a label in F. E. Edwards' hand "Headon Hill". The preservation and colour of these carbonaceous endocarps strongly suggest that they were derived from an ironstone nodule.

The form of the endocarp, mode of dehiscence and position of the funicle indicate the family Icacinaceae. The cylindrical canals which pierce the wall place the specimens in *Stizocarya* Reid & Chandler, a genus based originally on London Clay material. The endocarps agree closely in size and shape with *S. communis*, but in that species the canals are about 0.6 to 1 mm. apart and not therefore so close as in the species here described.

In view of the uncertainty as to the origin of the specimens no specific name has been given. Nevertheless they are of interest and importance as they indicate the presence of Icacinaceae in the Tertiary of the Isle of Wight and are certainly from a younger horizon than the London Clay. The probable occurrence in ironstone nodules suggests the Headon Beds. It is much to be hoped that further material will be found which will elucidate the origin of these endocarps. In addition to V.43928 which is figured, there is an endocarp V.43929.

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EXPLANATION OF PLATES

FIGS. 1-141 all from the cliffs of Colwell Bay, Isle of Wight, except figs. 16-19, 64, 65, 67-69 from the Lower Headon of Hordle, Hampshire (for comparison). Unless otherwise stated Colwell specimens are from Upper Headon Beds between Brambles and Linstone Chines.

PLATE 27

? *Araucarites gurnardi* Florin

FIGS. 1, 2. Distal end of cone-scale, base broken; short rounded apical process may be abraded. Fig. 1 dorsal surface, escutcheon above, *e*. Fig. 2 ventral. $\times 6.5$. (V.43780.) Below sewer pipe, Linstone Chine.

Sequoia coultisiae Heer

FIG. 3. Twig tip with remains of male cone showing anthers. $\times 36$. (V.44841.)

FIG. 4. Part of same at \times in fig. 3. $\times 161$. Between Colwell and Brambles Chines.

Pinus sp.

FIG. 5. Seed, upper surface showing cell structure; *m*, micropyle; *c*, cells of testa seen in section in edge of broken valve fragment. $\times 20$. (V.43785.)

Potamogeton pygmaeus Chandler

FIGS. 6, 7. Endocarps with spines, keel, *k*, gaping; *p*, spiny process on ventral margin; *s*, style. $\times 18.75$. (V.43787-88.) Below sewer pipe, Linstone Chine.

FIG. 8. Abraded endocarp with almost smooth contours crushed so that median gap between limbs appears small. $\times 18.75$. (V.43793.)

Limnocarplus forbesi (Heer)

FIGS. 9, 10. Two endocarps in pyrites; *s*, style; *k*, keel. $\times 14$. (V.43794-95.)

Stratiotes headonensis Chandler

FIGS. 11-19. Seeds. Fig. 15 small abortive specimen (V.43803). All others represented by one valve only. Figs. 11, 13, 14, 16, 19 show external surface. Figs. 12, 17, 18 internal surface with raphe canal, marginal in lower part, diagonal to apical chalaza above. Exceptional width of keel well shown in figs. 12, 18, 19. Figs. 16, 17 outer and inner surfaces respectively of a single seed and figs. 18, 19 of another. Figs. 11-15 $\times 6.5$. Figs. 16-19 $\times 8$. Figs. 11, 12 between Brambles and Linstone Chines. (V.43799-V.43800.) Figs. 13-15 below sewer pipe, Linstone Chine. (V.43801-03.) Figs. 16-19 for comparison from Lower Headon of Hordle. (V.42073, V.42078.)



PLATE 28

Carex sp.

- FIGS. 20, 21. Endocarp, opposite surfaces. Fig. 20 is the faceted side. $\times 20$. (Decayed.)
FIGS. 22, 23. Another, slightly broken at base. Faceted surface in fig. 23. $\times 20$. (Decayed.)

- FIGS. 24, 25. Endocarp, slightly imperfect at apex. Faceted surface in fig. 25. $\times 20$. (V.43807.)

Carex colwellensis n.sp.

- FIGS. 26, 27. Holotype. Endocarp, s, styles. $\times 20$. (V.43808.)

? *Scirpus* sp.

- FIG. 28. Fruit with longitudinal ridges. $\times 20$. (V.43809.)

? *Caricoidea obscura* Chandler

- FIGS. 29, 30. Two endocarps. $\times 15$. (V.43824, V.43826.)

Caricoidea (? *Cladium*) *colwellensis* n. sp.

- FIG. 31. Broad endocarp. $\times 14$. (V.43812.)

- FIG. 32. Holotype. Endocarp. $\times 14$. (V.43810.)

- FIG. 33. Small endocarp. $\times 14$. (V.43811.)

- FIG. 34. Endocarp showing longitudinal ridge. $\times 14$. (Decayed.)

- FIG. 35. Endocarp tilted to show basal aperture. $\times 14$. (Decayed.)

Caricoidea maxima Chandler

- FIG. 36. Fruit, side. $\times 14$. (V.43815.)

- FIG. 37. Another fractured longitudinally but irregularly so that upper half of endocarp, *e*, is exposed in longitudinal section. Its lower end lay about one-quarter of the length of the fruit from its base. Some coarse polygonal cells preserved in pyrites seen near the base of the cavity may be adherent foreign tissue. $\times 14$. (Decayed.)

- FIG. 38. Another fruit abraded at base so that endocarp is exposed showing basal aperture. $\times 14$. (Decayed.)

- FIG. 39. Endocarp released from fruit tilted to show apex, so that neck, *n*, almost hidden. $\times 14$. (V.43816.)

- FIG. 40. Another endocarp with conspicuous neck but no apical mucro. Tilted to show apex. $\times 9$. (V.43817.)

? *Caricoidea angulata* Chandler

- FIGS. 41, 42. Two endocarps. $\times 14$. (V.43818-19.)

Cyperaceae. Genus ?

- FIGS. 43, 44. Opposite sides of a crushed triangular fruit, apex incomplete. $\times 20$. (V.43829.)

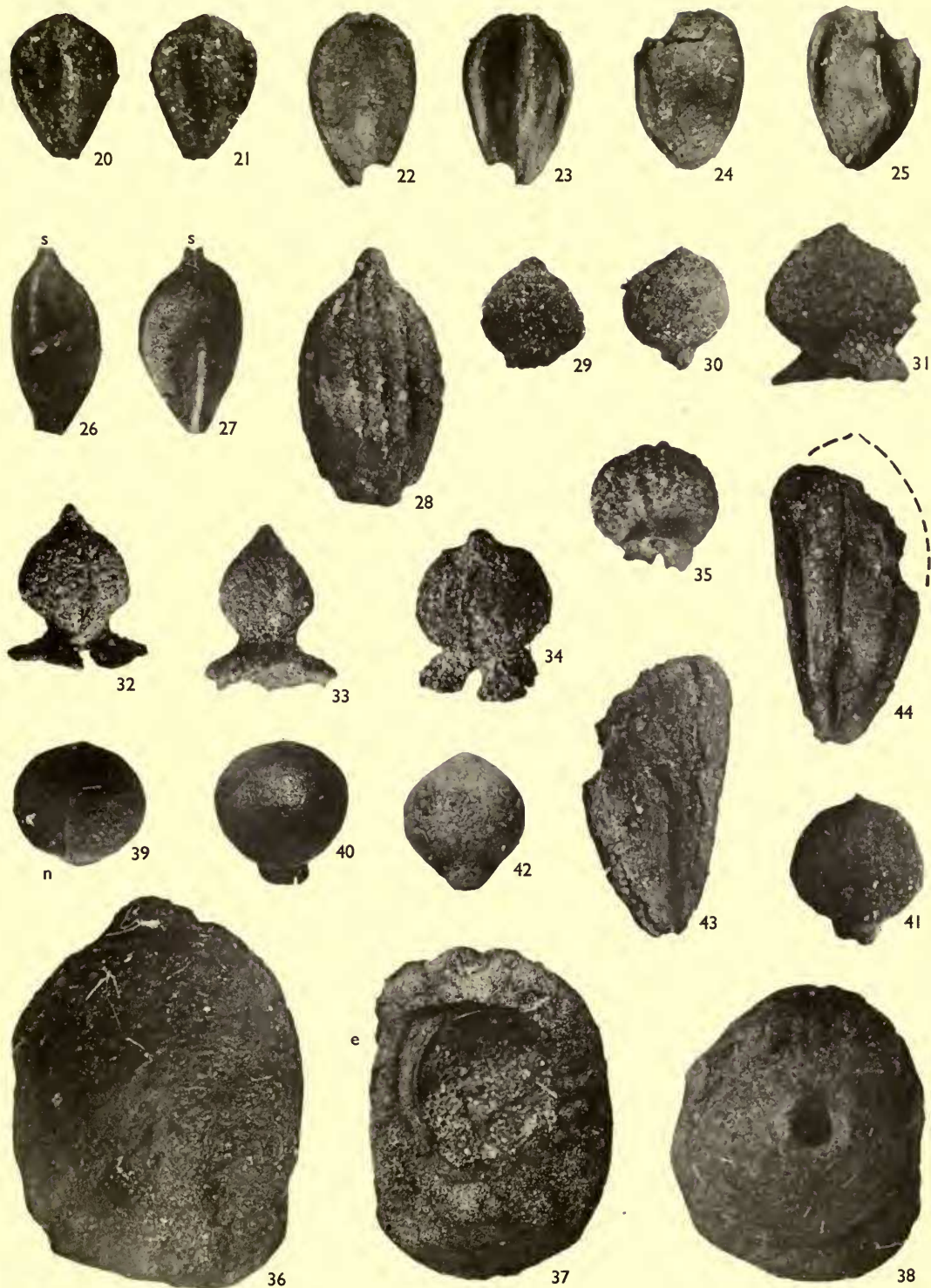


PLATE 29

Myrica boveyana (Heer)

- FIG. 45. Valve of endocarp, much abraded. $\times 9.5$. (V.43832.)
FIG. 46. Same, inner side showing characteristic form of locule; stylar canal at apex; *v*, vascular canal. Note broad sutures. $\times 9.5$.
FIG. 47. Better preserved fruit, exterior of valve (cut off on left by edge of plate). $\times 15.5$. (V.43831.)
FIG. 48. Inner surface of one valve of the above, *st*, stylar canal; *v*, vascular canal. $\times 15.5$.

Myrica ? colwellensis n.sp.

- FIG. 49. Holotype. Endocarp, exterior, showing longitudinal furrows with fibres. $\times 15$. (V.43834.)
FIG. 50. Valve of same, inner surface, showing typical locule and coarse cells of locule lining; *st*, stylar canal; *s*, crumpled seed; *v*, vascular canal. $\times 15$.
FIG. 51. Second valve of same, exterior, bitten by insect (?), on right. $\times 15$.
FIG. 52. Valve of endocarp, exterior, imperfect above. $\times 9.5$. (V.43835.)
FIG. 53. Same, inner face; *v*, vascular canal. $\times 9.5$.
FIG. 54. Valve of abraded endocarp, exterior. $\times 9.5$. (V.43836.)
FIG. 55. Same, inner surface, *st*, stylar canal. (Cavity full of sand grains.) $\times 9.5$.

Ficus lucidus Chandler

- FIG. 56. Crushed endocarp, burst at *p* overlying placenta, $\times 20$. (V.43838.)

Centrospermae. Family? Genus?

- FIG. 57. Seed bursting at hilum. $\times 20$. (V.43839.)

Brasenia ovula (Brongniart)

- FIG. 58. Seed without embryotega, aperture for which is at *a*. $\times 15.5$. (V.43841.)
FIG. 59. Smaller seed. $\times 15.5$. (V.43840.) Both the above from south of Brambles Chine.

Nymphaea sp.

- FIG. 60. Seed with embryotega, *e*. $\times 15$. (V.43850.)
FIG. 61. Another, embryotega missing. $\times 15$. (V.43851.)

Nymphaeaceae. Genus? (? *Brasenia ovula*)

- FIG. 62. Hilar end of dorsiventrally crushed seed with embryotega just below centre of figure showing micropyle surrounded by radially arranged cells. $\times 15$. (V.43852.)



PLATE 30

Brasenia spinosa Chandler

- FIG. 63. Seed, tilted to show aperture for embryotega. $\times 15$. (V.43844.)
FIG. 64. A seed, somewhat laterally compressed, apex showing aperture as in Fig. 63. $\times 15$. (V.42121a.)
FIG. 65. Another tilted to show fine basal spines. $\times 15$. (V.42121.)
FIG. 66. Apex of a seed with embryotega preserved showing small rimmed micropyle. $\times 15$. (Decayed.)
FIG. 67. Smaller seed tilted to show embryotega at apex. Stout tubercles are seen. $\times 15$. (V.20042a.)
FIG. 68. Another, side. $\times 15$. (V.20041.)
FIG. 69. Another, tilted to show aperture for embryotega. $\times 15$. (V.20041b.)
Figs. 64, 65, 67-69 from Lower Headon, Hordle for comparison. Figs. 64, 65 show seeds with slender spines. Figs. 67-69 are the variety with stout tubercles formerly separated as *Brasenia antiqua*.

Aldrovanda ovata (Chandler)

- FIG. 70. Typical seed with long neck. $\times 15$. (V.43853.)
FIG. 71. Another, bursting so as to show inner coat. $\times 15$. (V.43854.) Below sewer pipe, Linstone Chine.

? *Rubus microspermus* C. & E. M. Reid

- FIG. 72. Endocarp. $\times 20$. (V.43859.)
FIG. 73. Another, abraded showing curved form. $\times 20$. (V.43860.) Below sewer pipe, Linstone Chine.

Zanthoxylum hordwellense Chandler

- FIG. 74. Seed, side. Long hilar scar at *h*. $\times 9$. (V.43862.)
FIG. 75. Another, *h* as above. $\times 9$. (Decayed.)
FIG. 76. Seed with more rounded outline. $\times 9$. (V.43863.)
FIG. 77. Seed tilted to show hilar scar near right margin of figure. $\times 9.5$. (V.43864.)
FIG. 78. More elongate seed tilted to show ventral margin with long narrow hilar scar in upper half. Hilar aperture in both at lower end of scar. $\times 9.5$. (V.43865.)
FIG. 79. Same, side, hilar scar on left. *a*, position of hilar aperture. $\times 9$.
FIG. 80. Seed in Fig. 77, side, hilar scar on right. $\times 9$.

Hordwellia crassisperma (Chandler)

- FIG. 81. Fruit, apex, with small subcircular perianth scar. $\times 20$. (V.43868.)
FIG. 82. Seed, slightly broken at top of figure. Hilum at base. $\times 20$. (V.43869.)
FIG. 83. Seed differently preserved in pyrites. $\times 20$. (Decayed.)
FIG. 84. Somewhat crushed seed. $\times 20$. (Decayed.)
FIG. 85. Typical larger seed. $\times 20$. (V.43870.)

Decodon vectensis n.sp.

- FIG. 86. Holotype. Seed, side, somewhat tilted to show valve on right beginning to gape at *v*. $\times 20$. (V.43873.)
FIG. 87. Same, opposite side in true profile. Valve, *v*. $\times 20$.
FIG. 88. Slender seed, valve, *v*, on left with concave outline. $\times 20$. (V.43874.)
FIG. 89. Same, with valve on right, tilted so that it occupies half breadth of figure. $\times 20$.
FIG. 90. Another, valve, *v*, gaping on right at base. $\times 20$. (V.43875.)

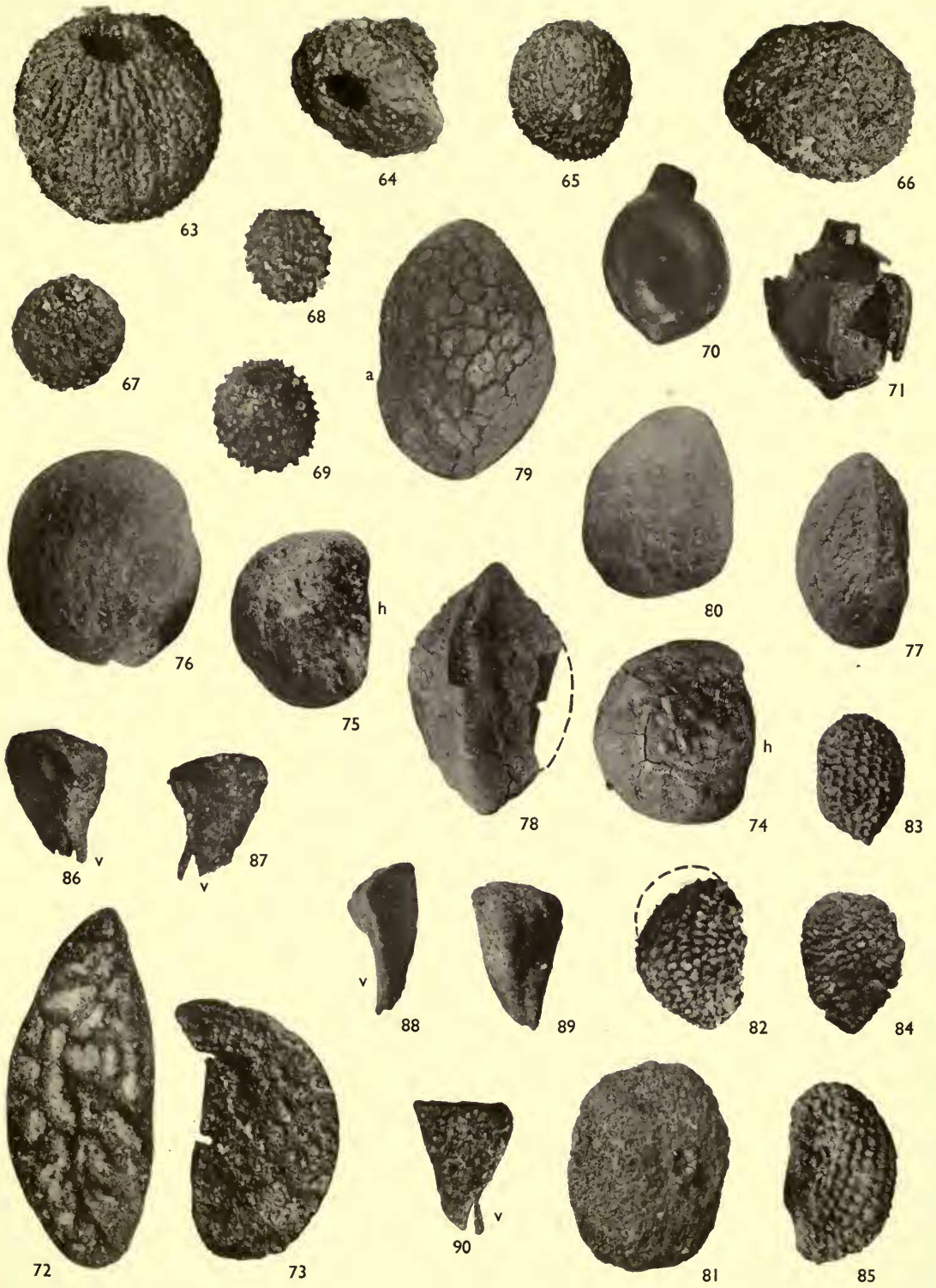


PLATE 31

Decodon vectensis n.sp.

- FIG. 91. Same seed as in Pl. 30, fig. 90. Valve on left. $\times 20$.
 FIG. 92. Seed with dorsal angle on right. $\times 20$. (Decayed.)
 FIG. 93. Ungerminated seed with closed valve on right. $\times 20$. (V.43876.)
 FIG. 94. Seed, ? abortive, looking onto slightly concave valve which extends almost to apex as shown by crack along its left margin. $\times 20$. (V.43877.)
 FIG. 95. Abortive seed. $\times 20$. (Decayed.)
 FIG. 96. Seed with cavity turned to left exposed by loss of valve. $\times 20$. (V.43878.)
 FIG. 97. Seed, edge of valve on left, dorsal angle forms outline on right. $\times 20$. (V.43879.)
 FIG. 98. Same, left edge is the dorsal angle, locule lies behind on right. $\times 20$.

? *Microdiptera parva* Chandler

- FIG. 99. Seed, dorsal, showing pitted germination valve in lower half. $\times 20$. (V.43881.)
 FIG. 100. Same, ventral, showing broad longitudinal seed-body carrying raphe ridge. $\times 20$.
 FIG. 101. Seed, dorsal, with longer valve. $\times 20$. (V.43882.)
 FIG. 102. Same, ventral. $\times 20$.
 FIG. 103. Subquadrangular seed, dorsal, valve partly hidden by distortion of specimen. $\times 20$. (V.43883.)
 FIG. 104. Same, ventral, showing broad seed-body flanked by depressions. $\times 20$.
 FIG. 105. Seed, dorsal, valve slightly swollen and cracked towards its apex. $\times 20$. (V.43884.)
 FIG. 106. Same, ventral, broad body clear. $\times 20$.
 FIG. 107. Seed, dorsal, seed-cavity, *c*, exposed by loss of valve. $\times 20$. (Decayed.)

Sambucus colwellensis n.sp.

- FIG. 108. Holotype. Seed, ventral. $\times 20$. (V.43886.)
 FIG. 109. Another, dorsal. $\times 20$. (V.43887.)
 FIG. 110. Seed, ventral, *h*, hilum. $\times 20$. (V.43888.)
 FIG. 111. Small seed, ventral, splitting marginally as in germination. $\times 20$. (V.43889.)
 FIG. 112. Seed, ventral, *h*, hilum. $\times 20$. (V.34890.)
 FIG. 113. Crushed seed, ventral, splitting as in Fig. 111. $\times 20$. (V.43891.) Below sewer pipe, Linstone Chine.

Epacridicarpum headonense Chandler

- FIG. 114. Fruit tilted to show apex with loculicidal splitting. $\times 20$. (V.43894.)
 FIG. 115. Another, side, showing flat apex, domed base. $\times 20$. (V.43895.)
 FIG. 116. Base of a fruit with median attachment scar. $\times 20$. (V.43896.)

Epacridicarpum colwellense n.sp.

- FIG. 117. Holotype. Fruit, apex, showing winged angles over locules alternating with concavities, *s*, over septa. $\times 20$. (V.43898.)
 FIG. 118. Another, base, somewhat distorted. $\times 20$. (V.43899.)
 FIG. 119. Another, basilateral view. Distorted. $\times 20$. (V.43900.)



PLATE 32

Carpolithus colwellensis n.sp.

FIG. 120. Holotype. Fruit showing tiny perianth segments, *p*; median angle with furrow, flanked by lateral facets. Faintly rippled surface due to fine tubercles seen on left. Base somewhat abraded. $\times 20$. (V.43905.)

FIG. 121. Same, opposite flat surface. Two perianth segments clearly shown. $\times 20$.

FIG. 122. Another, angled surface, median furrow filled by white matrix. Broken at apex so that locule is exposed at *l*. Excavated base complete. $\times 20$. (V.43906.)

FIG. 123. Same, flat surface, base well shown. $\times 20$.

FIG. 124. Smaller fruit, faceted surface. $\times 20$. (V.43907.)

FIG. 125. Same, opposite flat surface. $\times 20$.

FIG. 126. Another, imperfect at base, in longitudinal section. $\times 20$. (V.43908.)

Carpolithus spp.

FIG. 127. Valve of ? capsule, bearing subterminal spine. $\times 9$. (V.43909.)

FIG. 128. Same, opposite, internal, surface. $\times 9$.

FIG. 129. Another, exterior, split below and somewhat collapsed. $\times 9.5$. (V.43910.)

FIG. 130. Same, opposite side with ? ruptured septum. $\times 9.5$.

FIG. 131. Small ovoid seed. $\times 20$. (V.43912.)

FIG. 132. Similar but more elongate specimen. $\times 20$. (V.43913.)

FIG. 133. Abraded fruit or seed with scar truncating apex. $\times 20$. (V.43914.)

Unknown leaf

FIG. 134. Lobed or segmented leaf or pinnule fragment, upper surface. $\times 20$. (Decayed.)

FIG. 135. Same, lower surface, showing broad convex midrib delimited by furrows. $\times 20$.

FIG. 136. Three lobes of a larger specimen, upper surface. $\times 20$. (V.43917.)

FIG. 137. Same, lower surface, showing broad midrib flanked by hollows partly concealed by recurved margins of lobes. (White patch a sand grain.) $\times 20$.

FIG. 138. Fragment near base of leaf with lobes diminishing in size downwards. Upper surface. $\times 20$. (V.43916.)

FIG. 139. Same, lower surface, showing conspicuous convex midrib. $\times 20$.

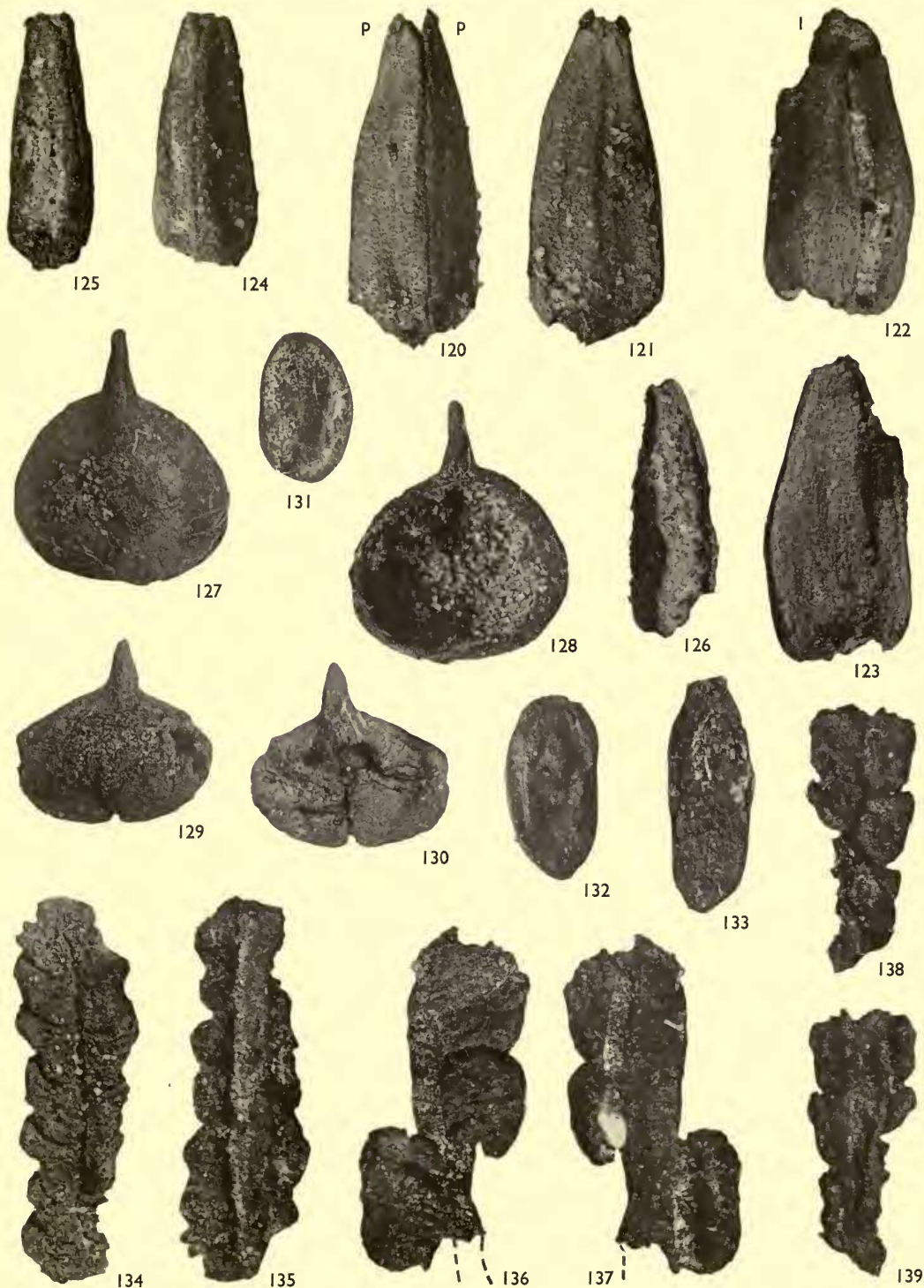






PLATE 33

Carpolithus sp.

FIG. 140. Fruit showing cavity exposed by partial splitting into two valves, one now incomplete. *a*, attachment scar. $\times 14$. (V.43915.)

FIG. 141. Same, opposite side, with obscure ribbing. Broken valve projects at *v*. $\times 14$.

Figs. 142-147 from Osborne Beds, Isle of Wight.

Acrostichum lanzaeanum (Visiani)

FIG. 142. Fragment of pinnule showing characteristic nervation. cf. Text-fig. 3. $\times 2.5$. No. 377 Geological Survey Museum from Cliff End near Colwell Bay.

? *Stratiotes neglectus* Chandler

FIGS. 143-146. Seeds or valves, small, crushed, probably abortive. Figs. 143-145 external surface. Fig. 146 internal surface. Figs. 144, 146 have the keel partly broken at *b* along the line of the raphe. *h*, position of hilum. $\times 6$. (V.43923-26.)

From Osborne.

Dicotylophyllum pinnatifidum Reid & Chandler

FIG. 147. Terminal fragment of leaf. $\times 6$ approx. No. 376 Geological Survey Museum, from Cliff End, Colwell Bay.

Figs. 148-165 from Bembridge Beds, Isle of Wight except Fig. 153 from Hamstead Beds for comparison.

? *Potamogeton* sp.

FIG. 148. Impression of upper surface of tuft of leaves still attached to stem. Crushed so as to give appearance of a whorl. $\times 1$. (V.23428.)

FIG. 149. Part of leaf at *x* in Fig. 148 showing toothed margin at *m* and series of nerves and bast bundles. $\times 3$. From Insect Limestone, Thorness Bay.

Limnocarpus forbesi (Heer)

FIG. 150. Endocarp, side, keel on right, *s*, style. Large lateral foramen, *l*, filled with matrix. Crushed but surface rugosities well preserved. $\times 15$. (V.43930.)

FIG. 151. Another, dorsilateral view, showing ridged keel. Style broken. $\times 15$. (V.43931.)

FIG. 152. Another, crushed and tilted to show tip of ridged keel. $\times 15$. (V.43932.) Marls below Chapel Corner, Wootton.

FIG. 153. Similar crushed endocarp for comparison with Fig. 151. Style broken. $\times 15$. (V.43960.) Waterlily Bed of Hamstead Beds, Hamstead cliff.



Stratiotes neglectus Chandler

- FIG. 154. Valve, exterior, typical seed. $\times 6.5$. (V.40079.)
 FIG. 155. Same, interior, showing diagonal raphe crossing keel on left. *m*, micropyle. $\times 6.5$.
 Marls, Hamstead Ledge.

Celtis edwardsi n.sp.

- FIG. 156. Holotype. Endocarp, side, showing reticulate surface. Margin lies in plane of symmetry. *a*, one of a pair of apical depressions. $\times 6.5$. (V.43919.)
 FIG. 157. Same at right angles to the above; *a, a*, apical depressions (part of system of reticulations). $\times 6.5$.
 FIG. 158. Same, apex, plane of symmetry vertical. Pair of depressions seen just above equator of figure. $\times 6.5$.
 FIG. 159. Same, base, plane of symmetry vertical. $\times 6.5$.
 FIG. 160. Internal cast of another endocarp (virtually equals seed) viewed at right angles to plane of symmetry, *p*, placenta. $\times 6.5$. (V.43920.) Bembridge Limestone, Headon Hill.

Ranunculus ovaliformis (Reid & Chandler)

- FIG. 161. Impression of achene with large recurved style, basal attachment and impressions of small tubercles in central area. $\times 6.5$. (V.23429.) Insect Limestone, Thorness Bay.

Carpolithus sp.

- FIG. 162. Valve of fruit or endocarp showing apical style, *s*, and basilateral flanges. $\times 4$.
 FIG. 163. Same, inner surface, showing basal canals and coarse network of fibres impressed on cavity wall. Also smooth marginal suture. $\times 5.5$.
 FIG. 164. Exterior of another specimen. $\times 4$.
 FIG. 165. Same, opposite side with near valve broken so that cavity and basal canal are shown. $\times 4$. From marly pocket in Bembridge Limestone, Sticelett Ledge, Isle of Wight. All in Sandown Museum, J. F. Jackson Coll.
 Figs. 166-204 from Hamstead Beds, Isle of Wight.

Typha latissima Al. Braun

- FIGS. 166-170. Five seeds truncated above by micropylar disc with central mucro, pointed chalazal end at base. $\times 15$. (V.43940-44.) "Waterlily Bed", Hamstead.

? *Sparganium multiloculare* Reid & Chandler

- FIG. 171. Endocarp, side. $\times 15$. (V.43947.)

Sparganium sp.

- FIG. 172. Endocarp, apex, showing aperture of stylar canal leading into locule. $\times 6.5$. (V.43948.)
 "White Band", Bouldnor cliff.

Potamogeton tenuicarpus C. & E. M. Reid

- FIGS. 173-176. Four endocarps, *v*, valve. $\times 15$. V.43949-50 from "Waterlily Bed", Hamstead. V.43954-55 from same at Bouldnor cliff.

Limnocarpus forbesi (Heer)

- FIG. 177. Uncrushed pyritized endocarp. $\times 12$. (Decayed.) Hamstead Beds, Hamstead cliff.

- FIG. 178. Another, side. *s*, stalk; *st*, style; keel on right. $\times 15$. (V.43957.) "Waterlily Bed", Hamstead cliff.

? *Caricoidea minima* (Chandler)

- FIGS. 179-180. Two endocarps. Fig. 180 shows lateral ridge and basal flange. $\times 12$. (V.43965-66.) Hamstead cliff.

Stratiotes neglectus Chandler

- FIG. 181. Seed, exterior. $\times 6.5$. (V.43968.)
 FIG. 182. Valve of seed, interior. $\times 6.5$. (V.43969.)
 In beds full of *Potamogeton turritissima* Hamstead cliff, said to come from the Hamstead Series.



PLATE 35

Stratiotes websteri (Brongniart)

- FIG. 183. Typical valve of seed, exterior. Keel on left. Collar, *c.* × 6. (V.43976.)
 FIG. 184. Another, inner surface, showing short transverse raphe. *h*, hilum; *m*, micropyle. × 6. (V.40072.)
 FIG. 185. Narrower small seed. Lettering as above. × 6. (V.43974.)
 FIG. 186. Relatively unabraded seed. Keel on right. × 6. (V.43975.) Hamstead cliff.

Stratiotes acuticostatus Chandler

- FIG. 187. Holotype. Seed, exterior, showing sharp interrupted ridges; *k*, broad keel. Note coarse pitting. × 6. (V.40075.)
 FIG. 188. Valve of another, inner surface, showing conspicuous raphe traversing keel on left; *m*, micropyle. × 6. (V.40074.)
 FIG. 189. Long narrow seed, exterior, with typical crested ridges. × 6. (V.44653.)
 FIGS. 190-192. Three small seeds, ? immature. Figs. 190, 191 show exterior, fig. 192 interior. × 6.5. (V.44174, V.44176, V.44179.)
 Bouldnor cliff.

Sabal major (Unger)

- FIG. 193. Impression of central part of a leaf with scanty carbonaceous remains. Shows tapering rachis and asymmetry at top of petiole. × 0.66. Middle Hamstead Beds, Hamstead. Sedgwick Museum, Cambridge, H. Keeping Coll.

Brasenia ovula (Brongniart)

- FIG. 194. Crushed seed with embryotega, *e.* × 12. (V.44185.) Hamstead cliff.

Leguminosae. Genus ?

- FIG. 195. Much crushed seed. × 12. (V.44192.) Hamstead cliff.

Aldrovanda intermedia Reid & Chandler

- FIG. 196. Seed looking onto raphe ridge. × 15. (V.44193.) Hamstead cliff.

? *Ilex* sp.

- FIG. 197. Dorsiventrally flattened endocarp. Scar of attachment median near base. × 12. (V.44194.) Hamstead cliff.

Carpolithus sp. (*Spirematospermum* sp. ?)

- FIG. 198. Part of pod; *s*, stalk ? White infilling lies within locule and is exposed where carpel wall has broken away. × 1. (41424.) Lower Hempstead Marls, Hempstead.

Carpolithus spp.

- FIG. 199. Crushed seed, possibly peculiarly preserved *Brasenia* with aperture for an embryotega at *e.* × 15. (V.44187.) Hamstead cliff.

- FIG. 200. Crushed seed with basal scar. × 12. (V.44200.) Hamstead cliff.

- FIGS. 201-204. Translucent tegmens of unidentified seed ? with conspicuous scar (chalaza ?) at one end. Two have split longitudinally at opposite end (Figs. 203, 204) perhaps as result of crushing. × 15. (V.44201-03, Fig. 201 decayed.) "Waterlily Bed", Hamstead cliff.

- FIGS. 205, 206. F. E. Edwards Collection Headon Hill in ironstone nodule ? Horizon ? possibly Lower or Upper Headon.

Stizocarya sp.

- FIG. 205. Valve of endocarp, exterior. × 3. (V.43928.)

- FIG. 206. Same, inner surface, showing apical part of funicular canal traversing wall to sub-apical placenta. Canal abraded below *f.* × 3.

